

TRANSPORTATION TECHNOLOGY SUPPORT
FOR DEVELOPING COUNTRIES

COMPENDIUM 14

Training

El entrenamiento

La formation technique

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Notice

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Cover photo: Supervisory personnel take refresher course in surveying at training center in Ethiopia.



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Project Description

The development of agriculture, the distribution of food, the provision of health services, and the access to information through educational services and other forms of communication in rural regions of developing countries all heavily depend on transport facilities. Although rail and water facilities may play important roles in certain areas, a dominant and universal need is for road systems that provide an assured and yet relatively inexpensive means for the movement of people and goods. The bulk of this need is for low-volume roads that generally carry only 5 to 10 vehicles a day and that seldom carry as many as 400 vehicles a day.

The planning, design, construction, and maintenance of low-volume roads for rural regions of developing countries can be greatly enhanced with respect to economics, quality, and performance by the use of low-volume road technology that is available in many parts of the world. Much of this technology has been produced during the developmental phases of what are now the more developed countries, and some is continually produced in both the less and the more developed countries. Some of the technology has been documented in papers, articles, and reports that have been written by experts in the field. But much of the technology is

Descripción del proyecto

En las regiones rurales de países en desarrollo, el desarrollo de la agricultura, la distribución de víveres, la provisión de servicios de sanidad, y el acceso a información por medio de servicios educacionales y otras formas de comunicación, dependen en gran parte de los medios de transporte. Aunque en ciertas áreas los medios de ferrocarril y agua desempeñan un papel importante, existe una necesidad universal y dominante de crear sistemas viales que provean un medio asegurado pero relativamente poco costoso para el movimiento de gente y mercancías. La mayor parte de esta necesidad se solucionaría con la construcción de caminos de bajo volumen que generalmente moverían únicamente de 5 a 10 vehículos por día y que pocas veces moverían tanto como 400 vehículos por día.

El planeamiento, diseño, construcción y mantenimiento de caminos de bajo volumen para regiones rurales de países en desarrollo pueden ser mejorados, con respecto al costo, calidad, y rendimiento, por el uso de la tecnología de caminos de bajo volumen que se encuentra disponible en muchas partes del mundo. Mucha de esta tecnología ha sido producida durante las épocas de desarrollo de lo que ahora son los países más desarrollados, y alguna se produce continuamente en estos países así como en los países menos desarrollados. Parte de la tecnología se ha documentado en disertaciones, artículos, e informes que han sido escritos por expertos en el campo. Pero mucha de la tecnología no está documentada y existe principalmente en la memoria de aquellos que han desa-

Description du projet

Dans les régions rurales des pays en voie de développement, l'exploitation agricole, la distribution des produits alimentaires, l'accès aux services médicaux, l'accès aux matériaux et aux marchandises, à l'information et aux autres services, dépendent en grande partie des moyens de transport. Bien que les transports par voie ferrée et par voie navigable jouent un rôle important dans certaines régions, un besoin dominant et universel existe d'un réseau routier qui puisse

assurer avec certitude et d'une façon relativement bon marché, le déplacement des habitants, et le transport des marchandises. La plus grande partie de ce besoin peut être satisfaite par la construction de routes à faible capacité, capables d'accueillir un trafic de 5 à 10 véhicules par jour, ou plus rarement, jusqu'à 400 véhicules par jour.

L'utilisation des connaissances actuelles en technologie, qui sont accessibles dans beau-

undocumented and exists mainly in the minds of those who have developed and applied the technology through necessity. In either case, existing knowledge about low-volume road technology is widely dispersed geographically, is quite varied in the language and the form of its existence, and is not readily available for application to the needs of developing countries.

In October 1977 the Transportation Research Board (TRB) began this 3-year special project under the sponsorship of the U.S. Agency for International Development (AID) to enhance rural transportation in developing countries by providing improved access to existing information on

the planning, design, construction, and maintenance of low-volume roads. With advice and guidance from a project steering committee, TRB defines, produces, and transmits information products through a network of correspondents in developing countries. Broad goals for the ultimate impact of the project work are to promote effective use of existing information in the economic development of transportation infrastructure and thereby to enhance other aspects of rural development throughout the world.

In addition to the packaging and distribution of technical information, personal interactions with users are provided through field visits, con-

rollado y aplicado la tecnología por necesidad. En cualquier caso, los conocimientos en existencia sobre la tecnología de caminos de bajo volumen están grandemente esparcidos geográficamente, varían bastante con respecto al idioma y su forma, y no se encuentran fácilmente disponibles para su aplicación a las necesidades de los países en desarrollo.

En octubre de 1977 el Transportation Research Board (TRB) comenzó este proyecto especial de tres años de duración bajo el patrocinio de la U.S. Agency for International Development (AID) para mejorar el transporte rural en los países en desarrollo acrecentando la dispo-

nilidad de la información en existencia sobre el planeamiento, diseño, construcción, y mantenimiento de caminos de bajo volumen. Con el consejo y dirección de un comité de iniciativas para el proyecto, el TRB define, produce, y transmite productos informativos a través de una red de correspondientes en países en desarrollo. Las metas generales para el impacto final del trabajo del proyecto son la promoción del uso efectivo de la información en existencia en el desarrollo económico de la infraestructura de transporte y de esta forma mejorar otros aspectos del desarrollo rural a través del mundo.

Además de la recolección y distribución de la

coup de pays, peut faciliter l'étude des projets de construction, tracé et entretien, de routes à faible capacité dans les régions rurales des pays en voie de développement, surtout en ce qui concerne l'économie, la qualité, et la performance de ces routes. La majeure partie de cette technologie a été produite durant la phase de développement des pays que l'on appelle maintenant développés, et elle continue à être produite à la fois dans ces pays et dans les pays en voie de développement. Certains aspects de cette technologie ont été documentés dans des articles ou rapports écrits par des experts. Mais une grande partie des connaissances n'existe que dans l'esprit de ceux qui ont eu besoin de développer et appliquer cette technologie. De plus, dans ces deux cas, les écrits et connaissances sur la technologie des routes à faible capacité, sont dispersés géographiquement, sont écrits dans des langues différentes, et ne sont pas assez aisément accessibles pour être

appliqués aux besoins des pays en voie de développement.

En octobre 1977, le Transportation Research Board (TRB) initia ce projet, d'une durée de 3 ans, sous le patronage de l'U.S. Agency for International Development (AID), pour améliorer le transport rural dans les pays en voie de développement, en rendant plus accessible la documentation existante sur la conception, le tracé, la construction, et l'entretien des routes à faible capacité. Avec le conseil, et sous la conduite d'un comité de direction, TRB définit, produit, et transmet cette documentation à l'aide d'un réseau de correspondants dans les pays en voie de développement. Nous espérons que le résultat final de ce projet sera de favoriser l'utilisation de cette documentation, pour aider au développement économique de l'infrastructure des transports, et de cette façon mettre en valeur d'autres aspects d'exploitation rurale à travers le monde.

ferences in the United States and abroad, and other forms of communication.

Steering Committee

The Steering Committee is composed of experts who have knowledge of the physical and social characteristics of developing countries, knowledge of the needs of developing countries for transportation, knowledge of existing transportation technology, and experience in its use.

Major functions of the Steering Committee are to assist in the definition of users and their needs, the definition of information products that match user needs, and the identification of informational and human resources for development of the information products. Through its

información técnica, se provee acciones recíprocas personales con los usuarios por medio de visitas de campo, conferencias en los Estados Unidos de Norte América y en el extranjero, y otras formas de comunicación.

Comité de iniciativas

El comité de iniciativas se compone de expertos que tienen conocimiento de las características físicas y sociales de los países en desarrollo, conocimiento de las necesidades de transporte de los países en desarrollo, conocimiento de la tecnología de transporte en existencia, y experiencia en su uso.

Las funciones importantes del comité de iniciativas son las de ayudar en la definición de usuarios y sus necesidades, de productos informativos que se asemejan a las necesidades del usuario, y la identificación de recursos de

En plus de la dissémination de cette documentation technique, des visites, des conférences aux Etats Unis et à l'étranger, et d'autres formes de communication permettront une interaction constante avec les usagers.

Comité de direction

Le comité de direction est composé d'experts qui ont à la fois des connaissances sur les caractéristiques physiques et sociales des pays en voie de développement, sur leurs besoins au point de vue transports, sur la technologie actuelle des transports, et ont aussi de l'expérience quant à l'utilisation pratique de cette technologie.

Les fonctions majeures de ce comité sont d'abord d'aider à définir les usagers et leurs besoins, puis de définir leurs besoins en matière

membership the committee provides liaison with project-related activities and provides guidance for interactions with users. In general the Steering Committee gives overview advice and direction for all aspects of the project work.

The project staff has responsibility for the preparation and transmittal of information products, the development of a correspondence network throughout the user community, and interactions with users.

Information Products

Three types of information products are prepared: compendiums of documented information on relatively narrow topics, syntheses of knowledge and practice on somewhat broader

conocimientos y humanos para el desarrollo de los productos informativos. A través de sus miembros el comité provee vínculos con actividades relacionadas con el proyecto y también una guía para la interacción con los usuarios. En general el comité de iniciativas proporciona consejos y dirección general para todos los aspectos del trabajo de proyecto.

El personal de proyecto es responsable de la preparación y transmisión de los productos informativos, el desarrollo de una red de correspondencias a través de la comunidad de usuarios, y la interacción con los usuarios.

Productos informativos

Se preparan tres tipos de productos informativos: los compendios de la información documentada sobre temas relativamente limitados, la síntesis del conocimiento y práctica sobre temas

de documentation, et d'identifier les ressources documentaires et humaines nécessaires pour le développement de cette documentation. Par l'intermédiaire des ses membres, le comité pourvoit à la liaison entre les différentes fonctions relatives au projet, et dirige l'interaction avec les usagers. En général, le comité de direction conseille et dirige toutes les phases du projet.

Notre personnel est responsable de la préparation et de la dissémination des documents, du développement d'un réseau de correspondants pris dans la communauté d'usagers, et de l'interaction avec les usagers.

La documentation

Trois genres de documents sont préparés: des recueils dont le sujet est relativement limité, des

subjects, and proceedings of low-volume road conferences that are totally or partially supported by the project. Compendiums are prepared by project staff at the rate of about 6 per year; consultants are employed to prepare syntheses at the rate of 2 per year. At least one conference proceedings will be published during the 3-year period. In summary, this project aims to produce and distribute between 20 and 30 publications that cover much of what is known about low-volume road technology.

Interactions With Users

A number of mechanisms are used to provide interactions between the project and the user

community. Project news is published in each issue of *Transportation Research News*. Feedback forms are transmitted with the information products so that recipients have an opportunity to say how the products are beneficial and how they may be improved. Through semiannual visits to developing countries, the project staff acquires first-hand suggestions for the project work and can assist directly in specific technical problems. Additional opportunities for interaction with users arise through international and in-country conferences in which there is project participation. Finally, annual colloquiums are held for students from developing countries who are enrolled at U.S. universities.

viii un poco más amplios, y los expedientes de conferencias de caminos de bajo volumen que están totalmente o parcialmente amparados por el proyecto. El personal de proyecto prepara los compendios a razón de unos 6 por año; se utilizan consultores para preparar las síntesis a razón de 2 por año. Se publicará por lo menos un expediente de conferencia durante el período de tres años. En breve, este proyecto pretende producir y distribuir entre 20 y 30 publicaciones que cubren mucho de lo que se conoce de la tecnología de caminos de bajo volumen.

Interacción con los usuarios

Se utilizan varios mecanismos para proveer las interacciones entre el proyecto y la comunidad de usuarios. Se publican las noticias del pro-

yecto en cada edición de la *Transportation Research News*. Se transmiten, con los productos informativos, formularios de retroacción para que los recipientes tengan oportunidad de decir cómo benefician los productos y cómo pueden ser mejorados. A través de visitas semianuales a los países en desarrollo, el personal del proyecto adquiere directamente de fuentes originales sugerencias para el trabajo del proyecto y puede asistir directamente en problemas técnicos específicos. Surgen oportunidades adicionales para la interacción con los usuarios a través de conferencias internacionales y nacionales en donde participa el proyecto. Finalmente, se organizan diálogos con estudiantes de países en desarrollo que están inscriptos en universidades norteamericanas.

synthèses de connaissances et de pratique sur des sujets beaucoup plus généraux, et finalement des comptes-rendus de conférences sur les routes à faible capacité, qui seront organisées complètement ou en partie par notre projet. Environ 6 recueils par an sont préparés par notre personnel. Deux synthèses par an sont écrites par des experts pris à l'extérieur. Les comptes-rendus d'au moins une conférence seront écrits dans une période de 3 ans. En résumé, l'objet de ce projet est de produire et disséminer entre 20 et 30 documents qui couvriront l'essentiel des connaissances sur la technologie des routes à faible capacité.

Interaction avec les usagers

Un certain nombre de mécanismes sont utilisés pour assurer l'interaction entre le personnel du

projet et la communauté d'usagers. Un bulletin d'information est publié dans chaque numéro de *Transportation Research News*. Des formulaires sont joints aux documents, afin que les usagers aient l'opportunité de juger de la valeur de ces documents et de donner leur avis sur les moyens de les améliorer. Au cours de visites semi-annuelles dans les pays en voie de développement notre personnel obtient de première main des suggestions sur le bon fonctionnement du projet et peut aider à résoudre sur place certains problèmes techniques spécifiques. En outre, des conférences tenues soit aux Etats Unis, soit à l'étranger, sont l'occasion d'un échange d'idées entre notre personnel et les usagers. Finalement, des colloques annuels sont organisés pour les étudiants des pays en voie de développement qui étudient dans les universités américaines.

Foreword and Acknowledgments

This book is the sixteenth product of the Transportation Research Board's project on Transportation Technology Support for Developing Countries under the sponsorship of the U.S. Agency for International Development. The objective of this book is that it provide useful and practical information for those in developing countries who have direct responsibility for training.

Feedback from correspondents in developing countries will be solicited and used to assess the degree to which this objective has been attained and to influence the nature of later products.

Acknowledgment is made to the following publishers for their kind permission to reprint the selected text portions of this compendium: Transport and Road Research Laboratory, U.K.; Direktorat Jenderal Bina Marga, Indonesia; Commonwealth of Virginia, Department of Highways and Transportation, Richmond; and National Association of County Engineers, Washington, D.C.

Prefacio y agradecimientos

Este libro es el décimosexto producto del proyecto del Transportation Research Board sobre Apoyo de Tecnología de Transporte para Países en Desarrollo bajo el patrocinio de la U.S. Agency for International Development. El objetivo de este libro es el de proveer información útil y práctica para aquellos en países en desarrollo quienes tienen responsabilidad directa para el entrenamiento.

Se pedirá a los corresponsales en los países en desarrollo información sobre los resultados, para utilizarse en el asesoramiento del grado al cual se ha obtenido ese objetivo, y para influenciar la naturaleza de productos subsecuentes.

Se reconoce a los siguientes editores por el permiso dado para reimprimir las porciones de texto seleccionadas para este compendio: Transport and Road Research Laboratory, U.K.; Direktorat Jenderal Bina Marga, Indonesia; Commonwealth of Virginia, Department of Highways and Transportation, Richmond; y National Association of County Engineers, Washington, D.C.

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Avant-propos et remerciements

Ce livre représente le seizième volume du projet du Transportation Research Board sur la Technologie des transports à l'usage des pays en voie de développement. Ce projet est placé sous le patronage de l'U.S. Agency for International Development. L'objet de ce recueil est de réunir une documentation pratique et utile qui puisse aider les personnes responsables de la formation technique. La réaction des correspondants des pays en voie de développement sera sollicitée et utilisée pour évaluer à quel point le but proposé de ce projet

a été atteint, et pour influencer la nature des ouvrages à venir.

Nous remercions les éditeurs qui ont gracieusement donné leur permission de reproduire les textes sélectionnés pour ce recueil: Transport and Road Research Laboratory, U.K.; Direktorat Jenderal Bina Marga, Indonesia; Commonwealth of Virginia, Department of Highways and Transportation, Richmond; et National Association of County Engineers, Washington, D.C.

Appreciation is also expressed to libraries and information services that provided references and documents from which final selections were made for the selected texts and bibliography of this compendium. Special acknowledgment is made to the U.S. Department of Transportation Library Services Division and to the Library and Information Service of the U.K. Transport and Road Research Laboratory (TRRL).

Finally, the Transportation Research Board acknowledges the valuable advice and direction that have been provided by the project Steering Committee and is especially grateful to Kermit L. Bergstralh, Bergstralh Associates, Inc.; W.G. Wilson, International Road Federation, and John P. Zedalis, U.S. Agency for International Development, who provided special assistance on this particular compendium.

También se reconoce a las bibliotecas y servicios de información que proveen las referencias y documentos de los cuales se hacen las selecciones finales para los textos seleccionados y la bibliografía en este compendio. Se hace un especial reconocimiento a la Library Services Division del U.S. Department of Transportation y el Library and Information Service del U.K. Transport and Road Research Laboratory (TRRL).

Finalmente, el Transportation Research Board agradece el consejo y dirección valiosos provistos por el comité de iniciativas, con especial reconocimiento a los señores Kermit L. Bergstralh, Bergstralh Associates, Inc.; W.G. Wilson, International Road Federation, y John P. Zedalis, U.S. Agency for International Development, que prestaron ayuda especial para este compendio en particular.

Nos remercions aussi aux bibliothèques et bureaux de documentation qui nous ont fourni les documents et les références utilisés dans les textes choisis et bibliographie de ce recueil. Nous remercions spécialement la U.S. Department of Transportation Library Services Division et les Library and Information Service of the U.K. Transport and Road Research Laboratory (TRRL).

Finalment, le Transportation Research Board reconnaît la grande valeur de la direction et de l'assistance des membres du comité de direction et les remercie de leur concours et de la façon dont ils dirigent le projet, spécialement Kermit L. Bergstralh, Bergstralh Associates, Inc.; W.G. Wilson, International Road Federation, et John P. Zedalis, U.S. Agency for International Development, qui ont bien voulu prêter leur assistance à la préparation de ce recueil.

Overview

Background and Scope

Training is the teaching of work methods, techniques, and skills necessary for the satisfactory performance of specific work assignments. Training should be limited to the subject matter needed to perform particular jobs. Unnecessary material will impair the effectiveness of a training program. Education, on the other hand, is the process of developing the general knowledge, mind, and character of a person through the study of histories, theories, and principles. As such, it is the goal of formal educational institutions and beyond the scope of this compendium.

Training programs for highway personnel in developing countries became an aspect of

foreign assistance from the developed countries shortly after World War II. With few exceptions, the first attempts were seminar-type presentations by highway experts for local highway officials. These were basically one-time training efforts. As foreign assistance increased, training became counterpart-oriented, or on-the-job training, where expatriate highway personnel under contract to build a road worked with local personnel.

During the years when the emphasis was on new construction, the lack of organized training efforts went unnoticed in many developing countries. Each construction project was a separate entity, with foreign experts to ensure completion

Vista General

Antecedentes y alcance

El entrenamiento consiste en la enseñanza de los métodos de trabajo, las técnicas y la destreza necesarios para ejecutar satisfactoriamente asignaciones específicas de trabajo. El entrenamiento debe limitarse a lo estrictamente necesario para ejecutar trabajos particulares. El material innecesario perjudicará la efectividad de un programa de entrenamiento. Por otra parte, educación es el proceso de desarrollar el conocimiento general, la mente y el carácter de una persona a través del estudio de anteceden-

tes, teorías y principios. Tal es el objetivo de las instituciones educacionales formales, lo cual está fuera del alcance de este compendio.

Los programas de entrenamiento para el personal de carreteras de países en desarrollo llegaron a representar, poco después de la Segunda Guerra Mundial, un aspecto de ayuda extranjera de los países desarrollados. Con pocas excepciones, los primeros intentos fueron presentaciones tipo seminario para funcionarios locales de carreteras a cargo de expertos viales.

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Exposé

Historique et description

La formation technique consiste en l'enseignement des méthodes de travail et des techniques nécessaires pour mener à bien certaines tâches déterminées. La formation se limite aux connaissances indispensables pour réaliser certaines tâches spécifiques. L'enseignement de matières superflues diminuerait son efficacité. L'éducation, par contre, a pour but de développer les connaissances générales, l'esprit et le caractère d'une personne par l'étude des antécédents, des théories et des principes. En tant que telle, elle relève des institutions d'enseignement tradi-

tionnel et dépasse les limites du sujet de ce recueil.

Les programmes de formation pour le personnel routier des pays en voie de développement ont fait l'objet de l'aide provenant des pays industrialisés peu après la seconde guerre mondiale. A part quelques exceptions, les premières tentatives consistèrent en des conférences du genre séminaire données par des experts des routes aux administrateurs locaux. Il s'agissait principalement d'efforts ponctuels de formation. Avec l'accroissement

no matter how much or how little the local road organization was involved. Some lending agencies did encourage formal training programs as a part of the grants or loans for these capital improvements. These programs usually ran concurrently with construction operations. They were intended to train specific personnel with little concern for future needs or countrywide training requirements.

As these capital projects were completed, the maintenance of the growing highway network became the economic and technical responsibility of the local government. The lack of trained and experienced personnel to perform maintenance activities developed into a major concern for both the local government and the foreign lending agencies when the capital improvements in the highway infrastructure began to deteriorate at an unforeseen rate.

The lack of maintenance training was not limited just to developing countries, however. Developed countries also found that the increasing maintenance load highlighted inefficiencies and poor management practices that had previously been overlooked. A worldwide effort has been undertaken to improve and standardize maintenance activities by using comprehensive ongoing training programs. Although several different training philosophies have emerged, i.e., training centers, training production units (TPUs), and decentralized training, the basic objective of each approach to training is very similar. Compendium 14 draws heavily on maintenance training programs because the most recent developments have occurred in this area. However, the training techniques described are equally applicable to other areas of highway department activities, e.g., management, planning,

Estos fueron básicamente esfuerzos aislados de entrenamiento. A medida que aumentó la ayuda extranjera, el entrenamiento llegó a estar orientado a la contraparte local o al entrenamiento en el trabajo, donde el personal extranjero de carreteras contratado para construir un camino trabajaba con el personal local.

xii A través de los años cuando se daba énfasis a las nuevas construcciones, la falta de esfuerzos organizados de entrenamiento pasó desapercibida en muchos países en desarrollo. Cada proyecto de construcción era una entidad separada, con expertos extranjeros para asegurar su terminación, sin importar la mayor o menor par-

ticipación que pudiera tener el organismo vial local. Algunas agencias prestatarias alentaron programas formales de entrenamiento como parte de las donaciones o préstamos para estos mejoramientos principales. Generalmente dichos programas se desarrollaban concurrentemente con las operaciones de construcción. Estuvieron dirigidos a entrenar personal específico preocupándose poco por las necesidades futuras o por la necesidad de entrenamiento a nivel nacional.

A medida que se completaban estos proyectos, la conservación de la creciente red de carreteras llegó a ser responsabilidad económica

de l'aide étrangère, la formation technique s'adressa au personnel local, ou elle devint une formation sur le tas, le personnel des routes étranger travaillant sous contrat à la construction d'une route avec le personnel local.

Durant les années où l'attention se concentrait sur les constructions nouvelles, le manque d'organisation dans les efforts de formation technique passa inaperçu dans la plupart des pays en voie de développement. Chaque projet de construction était individuel, et les experts étrangers en assuraient la réalisation, que les organismes routiers locaux y participent activement ou non. Certains organismes de prêt encourageaient l'instauration de programmes de formation comme partie intégrante des subventions ou prêts destinés aux investissements. Ces programmes allaient de pair avec les travaux de construction. Ils avaient pour but de former un certain personnel sans se préoccuper des besoins futurs ni de la formation nécessaire au niveau national.

Une fois ces projets terminés, les autorités locales furent chargées, sur le plan économique et technique, de l'entretien d'un réseau routier de plus en plus étendu. Le manque de personnel préparé et expert en entretien devint l'une des majeures préoccupations tant des autorités locales que des organismes étrangers de prêt lorsque les investissements dans l'infrastructure routière commencèrent à se détériorer avec une rapidité surprenante.

Cependant, le manque de formation technique pour l'entretien ne se faisait pas sentir uniquement dans les pays en voie de développement. Les pays riches découvraient également que les besoins grandissants d'entretien mettaient en évidence une inefficacité et une mauvaise gestion qui jusque là étaient passées inaperçues. Depuis lors, un effort mondial a été entrepris afin d'améliorer et de standardiser les opérations d'entretien par la mise en oeuvre de vastes programmes de formation continue. Malgré la diversité des récentes philosophies

surveying, design, materials investigations, construction, and support functions.

Training is an investment in a country's human resources. As such, it should be evaluated like any other investment. Training should never be undertaken merely for the sake of training.

Rationale for This Compendium

The three most common approaches to formal training are (a) training centers, (b) TPUs, and (c) decentralized training.

Training centers are fixed facilities that have classrooms, offices, shops, garages, sleeping quarters, and dining facilities. The staff is comprised of professional trainers. The trainees are transported to the training center where they participate in classroom discussion and in operational exercises where they perform simulated

work. Training centers usually offer the most intensive programs, which, in turn, reduce training time.

Training production units are located in an area where work is required. They are temporary or permanent camps that have additional classroom facilities. The staff is a cadre of professional trainers. The trainees are responsible for the construction or maintenance of a portion of an actual road network reserved for exclusive use by the TPU. The trainees are shipped to the camp where they undergo classroom discussions and do actual work on the road system assigned to the TPU. Usually, the training period is longer at a TPU than at a training center, and the number of trainees and types of training are less flexible. However, trainees must face actual work problems, and their work output offsets some of the training costs.

y técnica del gobierno local. La falta de personal entrenado y experimentado para ejecutar las actividades de conservación se convirtió en una preocupación principal, tanto para el gobierno local como para las agencias prestatarias extranjeras, cuando los mejoramientos capitales ejecutados en la estructura vial empezaron a deteriorarse en una proporción imprevista.

Sin embargo, la falta de entrenamiento en conservación no estaba limitada solamente a los países en desarrollo. También los países desarrollados comprobaron que la creciente carga de conservación resaltó las deficiencias y las pobres prácticas administrativas que no habían sido tomadas en cuenta con anterioridad. Se ha emprendido un esfuerzo a nivel mundial para mejorar y normar las actividades de conservación empleando programas continuos e integrales de entrenamiento. Aunque han surgido di-

versas filosofías diferentes de entrenamiento, esto es, centros de entrenamiento, unidades de producción de entrenamiento, y entrenamiento descentralizado, el objetivo básico de cada enfoque es muy similar. El Compendio 14 incide bastante en los programas de entrenamiento en conservación dado que es esta área donde han ocurrido los más recientes cambios. Sin embargo, las técnicas de entrenamiento descritas son también aplicables a otras áreas de actividades del organismo vial, esto es, administración, planeamiento, topografía, diseño, investigación de materiales, construcción y funciones de apoyo.

El entrenamiento es una inversión en los recursos humanos de un país. Como tal, debe ser evaluado como cualquier otra inversión. Nunca debe emprenderse un entrenamiento por la sola razón del entrenamiento mismo.

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concernant la formation technique, telles que les centres de formation, les unités productives de formation et la formation décentralisée, l'objectif de base de chacune de ces approches est fondamentalement identique. Le recueil 14 traite surtout des programmes de formation technique pour l'entretien parce que c'est la branche qui s'est le plus développée récemment. Cependant, les techniques de formation décrites sont également applicables à d'autres activités du département des routes, telles que l'administration, la planification, le relevé de plans, l'étude, les recherches sur matériaux, la construction et les fonctions auxiliaires.

La formation technique représente un investissement dans les ressources humaines d'une

nation. Comme telle, il faut l'évaluer comme tout autre investissement. Un programme de formation ne doit être entrepris que pour une raison valable.

Objectif de ce recueil

Les trois approches les plus courantes à un programme de formation sont (a) les centres de formation, (b) les unités productives de formation et (c) une formation décentralisée. Les centres de formation sont des installations fixes qui comprennent des salles de classe, bureaux, magasins, garages, facilités de logement et de restauration. Le personnel se compose d'instructeurs professionnels. Les stagiaires se rendent au centre de formation où ils participent à des

Decentralized training takes place at the trainee's regular work location; therefore, separate training facilities are not required. The training material is prepared by training specialists, but the actual training is done by the trainee's supervisor. This places the control, timing, and amount of the training in the hands of the person who is responsible for the trainee's work. Decentralized training requires intensive preparation of complete and self-contained training programs by professional trainers and additional training for the supervisor-instructors. However, (a) the number of trainees is unlimited, (b) the training activity is completely flexible (allowing for minimal interruption to the trainee's work schedule), (c) the cost per trainee is nominal, and (d) trainees tend to pay strict attention to the training given by their supervisors.

Training should be a formal ongoing activity that takes place during regular work time. Its major objective is to teach each employee to do each work activity in the same, accepted way. Usually, a new training program is targeted at regular highway employees in order to standardize ongoing work methods. Once this immediate objective is obtained and the training methods have been perfected, the training program should be expanded to provide basic training for new employees and to prepare regular employees for advancement. Training opportunities should be provided for all levels of employees from management executives to field workers.

Training will be successful only if top management is fully cognizant of and committed to the value of a training program. Direct manage-

Exposición razonada para este compendio

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Las tres formas más comunes de acceso al entrenamiento formal son (a) centros de entrenamiento, (b) unidades de producción de entrenamiento (UPE), y (c) entrenamiento descentralizado. Los centros de entrenamiento son establecimientos fijos que tienen salones de clase, oficinas, talleres, garajes, dormitorios, servicio de comedor. El personal está formado por instructores profesionales. Los que reciben entrenamiento son transportados al centro de entrenamiento donde participan de exposiciones en clase y ejercicios operacionales mientras ejecutan trabajos simulados. Los centros de entrenamiento ofrecen generalmente los programas

más intensivos que, a su vez, reducen el tiempo de entrenamiento.

Las unidades de producción de entrenamiento están ubicadas en áreas donde se requiere el trabajo. Son campamentos temporales o permanentes que tienen adicionalmente salones de clase. El personal está formado por un conjunto de instructores profesionales. Los participantes son responsables de la construcción o conservación de un tramo de una red existente de caminos dedicada al uso exclusivo de la UPE. Los participantes son transportados al campo donde reciben exposiciones en clase y ejecutan el trabajo propiamente dicho en el sistema vial asignado a la UPE. Por lo general, el período de entrenamiento en una UPE es mayor que en un centro de entrenamiento, y el número

discussions en classe et à des exercices pratiques simulant les opérations. Les centres de formation offrent en général les programmes les plus intensifs, ce qui réduit ainsi le temps de formation.

Les unités productives de formation (UPF) se trouvent dans une zone où il existe un travail à réaliser. Ce sont des camps temporaires ou permanents qui comportent des salles de classe. Le personnel se compose d'instructeurs professionnels. Les stagiaires sont chargés de la construction ou de l'entretien d'un tronçon du réseau routier réservé à l'usage exclusif de la UPF. Les stagiaires sont envoyés au camp, où ils assistent à des discussions dans leur salle de classe et travaillent sur le tronçon de route assigné à la UPF. Généralement, la période de formation dans une UPF est plus longue que dans

un centre de formation, et le nombre de stagiaires ainsi que le genre de formation sont moins flexibles. Par contre, les stagiaires doivent affronter des problèmes réels, et le produit de leur travail compense une partie du coût de la formation.

La formation décentralisée prend place au lieu de travail habituel du stagiaire, aussi n'est-il pas nécessaire d'avoir recours à des installations spécialement conçues à cet effet. Des spécialistes en formation préparent le matériel, mais le cours est donné par le contremaître du stagiaire. De ce fait, le contrôle, la programmation et le niveau de formation sont entre les mains de la personne responsable du travail des stagiaires. La formation décentralisée requiert une préparation intensive de programmes de formation complets et indépendants les uns des autres,

rial involvement should begin with participation in the development of training material. Management must also be prepared to use new trainees effectively. Therefore, management must involve the senior staff in an active role in the development, execution, and follow-up of any training program. This will ensure jobs for the trainees and prevent frustration and defection of newly trained personnel.

Before any training program can be developed, a survey of available workers must be conducted. This survey should include the avail-

de participantes y tipos de entrenamiento son menos flexibles. Sin embargo, los alumnos deben resolver problemas reales de trabajo y el producto de su trabajo compensa en parte sus costos de entrenamiento.

El entrenamiento descentralizado se desarrolla en el lugar regular de trabajo del participante, en consecuencia, no se necesitan servicios separados para el entrenamiento. El material de entrenamiento es preparado por especialistas, pero el entrenamiento mismo está a cargo del supervisor. Esto localiza el control, duración y cantidad del entrenamiento en manos de la persona que es responsable del trabajo del participante. El entrenamiento descentralizado requiere de una intensiva preparación de programas perfeccionados y completos de entrenamiento a cargo de instructores profesionales, además del entrenamiento a cargo de supervisores-instructores. Sin embargo, (a) el número de participantes es limitado, (b) la actividad del entrenamiento es completamente flexible (permitiendo una mínima interrupción con el programa de trabajo del participante), (c) el costo por participante es nominal, y (d) los par-

par des instructeurs professionnels, ainsi qu'une formation spéciale pour les contremaîtres-instructeurs. Cependant, (a) le nombre de stagiaires est illimité, (b) le cours de formation est complètement flexible (ce qui permet un minimum d'interruption de l'horaire de travail du stagiaire), (c) le coût par stagiaire est nominal, et (d) les stagiaires ont tendance à observer strictement la formation donnée par leur contremaître.

La formation doit être une activité sérieuse et continue, qui ait lieu durant les heures habituelles de travail. Son but principal est d'enseigner à chaque employé comment exécuter chaque opération de son travail de la même façon, approuvée par le contremaître. En général, un nouveau programme de formation est donné aux employés permanents des routes, de façon à

ability of trainable people, as well as the current and projected personnel requirements of the highway organization. Such a survey will not only determine the feasibility of a training program but also will establish the magnitude and content of the program.

Training programs may be developed on either a subject-matter or a task-organization basis. The former is more commonly used at training centers, while the latter is more suited to decentralized training methods. The activity training is developed in the same manner for

ticipantes tienden a poner una estricta atención al entrenamiento que reciben de sus supervisores.

El entrenamiento debe ser una continua actividad formal que tiene lugar durante las horas regulares de trabajo. Su principal objetivo es enseñar a cada empleado a hacer cada actividad de trabajo de manera aceptable y similar. Por lo general, un programa nuevo de entrenamiento está dirigido a empleados permanentes de carreteras con el propósito de normalizar los métodos actuales de trabajo. Una vez que se obtiene este objetivo inmediato y se han perfeccionado los métodos de entrenamiento, debe ampliarse el programa para proporcionar un entrenamiento básico a los nuevos empleados y preparar a los empleados permanentes para futuras promociones. Debe brindarse oportunidad de entrenamiento a todos los niveles de empleados desde los ejecutivos administrativos hasta los trabajadores de campo.

Sólo tendrá éxito el entrenamiento si la administración superior está bien informada y confía en el valor de un programa de entrenamiento. La administración también debe estar prepa-

standardiser les méthodes de travail habituelles. Une fois cet objectif immédiat atteint et dès que les méthodes d'apprentissage ont été perfectionnées, le programme de formation peut s'étendre afin de fournir une formation de base à de nouveaux employés et de préparer les anciens à leur avancement. Les possibilités de formation technique doivent être offertes aux employés à tous niveaux, des cadres administratifs à la main-d'oeuvre sur chantier.

Le programme de formation ne sera couronné de succès que si la direction en reconnaît pleinement la valeur et s'y engage sérieusement. L'apport direct de la direction doit commencer par une participation au développement du matériel didactique. Elle doit également être prête à employer efficacement les nouveaux stagiaires. Pour ce faire, elle doit permettre au personnel

both types of programs, i.e., the training materials are work-oriented. However, in a subject-matter training program, the basic knowledge, skill, and ability (KSA) training, such as mathematics, usually precedes the actual job training. In decentralized performance-oriented training, the KSAs required to successfully complete the subject job are included in the specific training activity.

Any well-organized training program, no matter how large, can be broken down into components. Each component is a separate job element, or definable segment of work, to be performed. Tasks are units of work performed within job elements. Comprehensive training consists

of combining the various job elements into individual packages that are necessary for the completion of a trainee's specific duties. The trainee should not be burdened with task-activity training unrelated to the job. Furthermore, the individual should be trained in a specific work assignment immediately before undertaking it.

Training programs are developed on a component-by-component basis. Subject-matter specialists or groups of supervisors determine the correct procedures to be followed in the performance of a specific job element, such as repairing a pothole with available equipment and materials. Training specialists then break down the correct procedures into a series of single

rada para utilizar de modo efectivo al nuevo personal entrenado. En consecuencia, la administración debe involucrar en forma activa al personal más antiguo en el desarrollo, ejecución y continuación de cualquier programa de entrenamiento. Esto asegurará trabajo para los que reciben el entrenamiento y prevendrá frustraciones y abandono del nuevo personal entrenado.

Antes de desarrollar cualquier programa de entrenamiento, deberá hacerse una encuesta de los trabajadores disponibles. Esta encuesta debe incluir la disponibilidad de personas para entrenar, así como los requerimientos actuales y futuros del personal del organismo vial. Dicha encuesta no sólo determinará la factibilidad de un programa de entrenamiento sino que también establecerá la magnitud y contenido del programa.

Los programas de entrenamiento pueden desarrollarse sobre un determinado tema, o sobre una base de tarea y organización. El primero es el más comúnmente usado en los centros de entrenamiento descentralizado. La actividad del entrenamiento se desarrolla de igual manera en ambos tipos de programa, esto es, los materiales de entrenamiento están orientados al trabajo. Sin embargo, en un programa de entrenamiento sobre un determinado tema, el conocimiento básico, la destreza y el entrenamiento de la habilidad (esto es CDH), tal como las matemáticas, preceden generalmente al entrenamiento real en el trabajo. En un entrenamiento descentralizado orientado a la ejecución, los CDH requeridos para terminar exitosamente el trabajo seleccionado están incluidos en las actividades específicas del entrenamiento.

plus ancien de participer activement au développement, à l'exécution et à la continuation du programme. Ceci assurera un travail aux stagiaires et évitera la frustration et la défection du personnel nouvellement formé.

Avant d'entreprendre l'élaboration d'un programme de formation, il faut faire une étude de la main-d'oeuvre disponible, considérant la disponibilité des travailleurs à instruire ainsi que les besoins actuels et futurs en personnel de l'organisme routier. Une telle étude non seulement déterminera si le programme est faisable mais elle établira aussi son ampleur et son contenu.

Le programme de formation technique peut être établi en se basant sur un sujet déterminé ou sur l'organisation de la tâche. Le premier cas se présente souvent dans les centres de formation, tandis que le second convient mieux aux méthodes de formation décentralisée. Dans les deux cas, l'apprentissage d'une opération se déroule à peu près de la même façon, la matière

se rapporte au travail. Cependant, dans un programme centré sur un certain sujet, l'apprentissage des opérations est en général précédé par l'enseignement de connaissances de base telles que les mathématiques et d'une certaine capacité et habileté (KSA: knowledge, skill, ability). Dans la formation décentralisée portant directement sur l'exécution de la tâche, les connaissances de base, capacité et habileté (KSA) nécessaires pour réussir le travail sont incluses dans le programme de formation pour chaque opération.

Tout programme de formation bien organisé, aussi ample soit-il, peut être décomposé en ses parties constituantes. Chaque composante est une opération distincte, ou un segment définissable de travail à réaliser. Les activités sont des unités de travail exécutées au sein de chaque opération. Une formation d'ensemble consiste à combiner les diverses opérations en groupes individuels, qui seront nécessaires pour l'ac-

tasks that, when combined, constitute the proper execution of the specific job element. The training specialist is responsible for the preparation of the training texts, guides, and aids at the proper language level for the trainee population. Once the training component is developed by the training specialist, it is resubmitted to the subject-matter specialists for approval. Normally, the specific training component is then reviewed by management at the highest level downward to the trainee's immediate supervisor, both for comments on subject-matter content and as an informational source about the training their employees are to receive. This ensures the involvement of the supervisory personnel in the training procedure. The development and distribution of practical performance-oriented information in this manner may also indicate that a

perceived training need is really only an informational need, e.g., once a supervisor is alerted to the proper methods of executing a job element, employees may be capable of proper performance under the manager's direction without formal training.

Some useful hints for developing good job-oriented training activities are (a) start with simple ideas and advance in a logical manner to more complex ones, (b) use field-oriented problems and a language level that are understandable to the trainees, (c) explain why something should be done in a certain way and how to do it, (d) use different approaches to the same material, (e) emphasize the actions involved, (f) provide opportunities for trainee participation in both action and discussion, (g) make sure that the trainees understand each point before pro-

Cualquier programa de entrenamiento bien organizado, no importa cuán grande sea, puede dividirse en varios componentes. Cada componente es un elemento separado de trabajo o un segmento definido de trabajo por ejecutar. Las tareas son unidades de trabajo ejecutadas dentro de los elementos de la obra. El entrenamiento integral consiste en combinar los diversos elementos de la obra en paquetes individuales, necesarios para la terminación de las obligaciones específicas del participante. Este no debe sentirse agobiado con un entrenamiento de tarea-actividad que no esté relacionado con la obra. Más aún, el individuo debe ser entrenado en una asignación específica de trabajo, inmediatamente antes de encargarse de ella.

Los programas de entrenamiento se desarrollan sobre la base de componente por componente. Los especialistas o los grupos de supervisores de un determinado tema determinan los procedimientos correctos a seguir en la ejecu-

ción de un elemento específico de la obra, tal como reparar un bache empleando el equipo y los materiales disponibles. Los especialistas en entrenamiento pueden descomponer entonces los procedimientos correctos en una serie de tareas individuales que, cuando se combinan, constituyen la forma adecuada de ejecución del elemento del trabajo específico. El especialista en entrenamiento es responsable de la preparación de los textos, guías y medios auxiliares de entrenamiento en el nivel de idioma adecuado para la mayoría de los participantes. Una vez que el especialista en entrenamiento desarrolla el componente de entrenamiento, de vuelve a someter dicho componente a la aprobación de los especialistas en dicho tema. Normalmente, el componente específico de entrenamiento es entonces revisado por el más alto nivel administrativo hasta llegar al supervisor inmediato del participante, tanto para comentar sobre el contenido del tema en estudio como para utilizarlo

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complissement des fonctions spécifiques du stagiaire. Celui-ci ne doit pas être soumis à l'apprentissage de tâches sans relation avec son travail. D'autre part, chaque individu doit recevoir une formation se rapportant à la tâche spécifique qui lui a été assignée, immédiatement avant de l'entreprendre.

Les programmes de formation se développent progressivement. Des spécialistes de la matière étudiée ou des groupes de contremaîtres déterminent la méthode correcte à suivre pour l'exécution d'une certaine opération, telle que la réparation d'un nid de poule avec le matériel et les matériaux disponibles. Les spécialistes en enseignement technique décomposent alors

cette méthode en une série d'activités qui, une fois combinées, permettent d'exécuter l'opération correctement. L'expert en formation se charge de la préparation de textes, de guides et autre matériel didactique, rédigés dans un langage adapté au niveau des stagiaires. Une fois l'opération développée par l'expert en formation, elle est à nouveau soumise à l'approbation des spécialistes de la matière étudiée. Normalement, l'opération en cause est ensuite révisée successivement par la direction au plus haut niveau jusqu'au contremaître, supérieur immédiat des stagiaires, autant pour obtenir des commentaires sur le contenu que pour informer de la formation que recevront les employés. Ceci assure

ceeding, and (h) provide sufficient time for training, but remember that trainee discomfort limits the length of each session.

The efficiency of a training program is often measured by using pre- and post-training testing. This testing should measure objectively the trainee's grasp of the subject matter. However, testing generally has some drawbacks: (a) The trainee may be intimidated by the testing procedure, (b) the tests may not measure the proper achievements, or (c) the questions may be ambiguous. Moreover, post-testing does not indi-

cate the reason for the failure of an individual — e.g., whether the fault is in the training program, in the instructor's presentation, or in the inability of the trainee to assimilate training. Testing is used most successfully to measure action accomplishments such as the ability of an employee to complete a proper weld or to fill in a form. It is less successful in measuring decision-making ability. The only true measurement of the success of a training program is improved work-assignment performance.

como fuente de información sobre el entrenamiento que recibirán sus empleados. Esto asegura la participación del personal supervisor en el proceso de entrenamiento. Esta forma de distribuir la información práctica orientada a la ejecución, puede también indicar que la necesidad de un entrenamiento percibido es en realidad sólo una necesidad informativa; por ejemplo, una vez que se alerte a un supervisor sobre los métodos adecuados para ejecutar un elemento de trabajo, los empleados pueden ser capaces de ejecutarlo adecuadamente bajo la dirección del gerente, sin un entrenamiento formal.

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He aquí sugerencias útiles para desarrollar buenas actividades de entrenamiento orientadas al trabajo, (a) empiece con ideas simples y avance de una manera lógica a ideas más complejas, (b) use problemas orientados al trabajo y un nivel de lenguaje que sea comprensible para los participantes, (c) explique por qué

debe hacerse algo de cierta manera así como la forma de hacerlo, (d) use diferentes soluciones para el mismo material, (e) enfatice las acciones involucradas, (f) proporcione oportunidades para que el participante intervenga tanto en la acción como en la discusión, (g) asegúrese que los participantes comprendan cada punto antes de continuar, y (h) proporcione suficiente tiempo para entrenamiento pero recuerde que la incomodidad del participante limita la duración de cada sesión.

La eficiencia de un programa de entrenamiento se mide a menudo haciendo pruebas antes y después del entrenamiento. Estas pruebas deben medir objetivamente la comprensión del participante del tema en estudio. Sin embargo, dichas pruebas tienen algunos inconvenientes; (a) El participante puede sentirse intimidado por el proceso de la prueba, (b) las pruebas podrían dejar de medir sus propios logros, o (c) las preguntas pueden ser ambiguas.

la participation des contremaîtres au programme de formation. Il se peut également que les informations pratiques sur l'exécution du travail, ainsi développées et répandues, indiquent que ce que l'on croyait être un manque de formation n'était en réalité qu'un manque d'information; par exemple, une fois le contremaître au courant des méthodes conseillées pour l'exécution des opérations, les employés peuvent réaliser correctement leur tâche sous sa direction sans requérir une formation spéciale.

Nous présentons ici quelques suggestions pour faciliter le développement d'activités de formation valables et orientées vers le travail: (a) commencer par des idées simples et avancer de façon logique vers de plus complexes, (b) utiliser des problèmes en relation avec le travail de chantier et un langage qui soient compréhensibles aux stagiaires, (c) expliquer pourquoi certaines choses doivent être faites de telle façon, ainsi que comment les faire, (d) expliquer la même matière de diverses manières, (e) insister

sur les actions nécessaires, (f) donner au stagiaire la possibilité de participer aussi bien aux discussions qu'à la pratique, (g) s'assurer de ce que les stagiaires ont tout compris avant de poursuivre, et (h) permettre un temps de formation suffisant, tout en se rappelant que le stagiaire ne doit pas être incommodé par la longueur des sessions.

L'efficacité d'un programme de formation technique se mesure souvent par des tests réalisés avant et après ce programme. Ces tests devraient mesurer objectivement si le stagiaire a compris la matière étudiée. Ils présentent cependant certains inconvénients: (a) le stagiaire est parfois intimidé par le fait d'être soumis à des tests, (b) les résultats obtenus par ceux-ci ne reflètent pas toujours la réalité, ou (c) dans certains cas les questions sont ambiguës. En outre, le test postérieur au programme n'indique pas la raison de l'échec d'un individu, si c'est la faute du programme de formation, de l'exposé de l'instructeur, ou du manque de capacité

Discussion of Selected Texts

The first text, *Professional Training of Road Maintenance Personnel*, is excerpted from a paper presented at the Pan African Conference on Highway Maintenance and Rehabilitation in Ghana (United Nations Economic Commission for Africa, 1977). It defines the training (or education) required for three separate personnel levels: (a) top management, which usually requires a university degree; (b) middle-management and supervisory staff, which requires general technical training given at vocational and secondary technical in-country schools; and (c) skilled labor, who often must be trained in their specialties by a government training program.

Más aún, las pruebas posteriores no indican el motivo que origina las faltas de un individuo—por ejemplo, que la falta esté en el programa de entrenamiento, en la presentación del instructor, o en la incapacidad del participante para asimilar el entrenamiento. Se usan con mayor éxito las pruebas para medir los resultados de la acción, tales como la habilidad de un empleado para terminar una soldadura correcta o para rellenar un molde. Tiene menos éxito para medir su habilidad para tomar una decisión. La única medida real del éxito de un programa de entrenamiento es el mejoramiento en la ejecución del trabajo asignado.

Presentación de los textos seleccionados

El primer texto, *Professional Training of Road Maintenance Personnel* (Entrenamiento profesional del personal de conservación vial), ha sido extractado de un trabajo presentado en la

d'assimilation du stagiaire. Le test s'emploie avec succès pour mesurer les résultats d'une action, comme par exemple l'habileté d'un employé à souder correctement ou à remplir un formulaire. Il détermine plus difficilement s'il est capable de prendre une décision. Seule une amélioration du travail réalisé donne une mesure réelle du succès d'un programme de formation.

Discussion des textes choisis

Le premier texte, *Professional Training of Road Maintenance Personnel* (Formation professionnelle du personnel d'entretien des routes), est extrait d'un travail présenté à la Pan African Conference on Highway Maintenance and Rehabilitation (Conférence pan africaine sur l'entre-

The third group is the primary audience for the training programs described in this paper. Training activities take place, at least in part, in a formal training center or centers and are conducted by specialized instructors. Regional training, i.e., the use of a single training center by several countries to reduce the overhead of certain training facilities, is suggested for those training activities that are required for a small number of specialized personnel in each country. The paper assumes that the initial training will be conducted by foreign personnel until local counterpart instructors are developed. It considers such foreign training activities as technology transfer and explicitly warns that such technology must be modified to fit the existing social, economic, cultural, and technical

Conferencia Pan-Africana sobre Rehabilitación y Conservación de Carreteras en Ghana (Comisión Económica de las Naciones Unidas para el Africa, 1977). Define el entrenamiento (o educación) requerido para tres niveles separados de personal: (a) alta administración, que requiere generalmente de un grado universitario; (b) personal supervisor y de administración intermedia, que requiere un entrenamiento técnico generalmente dado en escuelas vocacionales y de secundaria técnica en el campo; y (c) mano de obra especializada, quienes a menudo deben ser entrenados en sus especialidades en un programa gubernamental de entrenamiento.

El tercer grupo conforma la audiencia principal para los programas de entrenamiento descritos en este trabajo. Las actividades de entrenamiento tienen lugar, por lo menos en parte, en un centro o centros formales de entrenamiento y están a cargo de instructores especializados. El entrenamiento regional, esto es, el uso de un

tien et la réfection des routes) au Ghana (United Nations Economic Commission for Africa, 1977). On y définit la formation (ou l'instruction) requise à trois différents niveaux de personnel: (a) la direction, qui requiert généralement d'un diplôme universitaire; (b) les cadres intermédiaires et les contremaîtres, pour lesquels on exige habituellement une formation technique générale obtenue dans des écoles professionnelles ou secondaires techniques du pays; et (c) la main-d'oeuvre spécialisée, qui doit souvent recevoir une formation dans sa spécialisation d'un programme de l'état.

Le troisième groupe fait l'objet principal des programmes de formation décrits dans ce recueil. La formation prend place, du moins en

conditions and traditions of the host country.

The paper contends that the modified technology for use in local training programs is not readily available on the world market. Therefore, many developing countries are forced to hire foreign consultants to completely redevelop training aids and material already available elsewhere. A more generous attitude toward the sharing of training information between developing countries and between professional trainers would help reduce this continuous reinvention of the wheel.

The text provides a general review of the problems encountered in the implementation of a training program in a developing country and suggests causes and/or solutions. It also suggests that the training of skilled personnel for higher-qualified supervisory posts, which is usually a long-term effort, can consist of short periods of formal training at a training center interspersed with longer periods of on-the-job training.

The second text, *Road Maintenance Training—The Work of a Specialist Organization*, is

centro único de entrenamiento para varios países, para reducir los gastos generales de ciertos servicios de entrenamiento, es recomendado para aquellas actividades de entrenamiento que son necesarias para un número reducido de personal especializado de cada país. El trabajo asume que el entrenamiento inicial estará a cargo de personal extranjero hasta que se preparen instructores locales de contraparte. Considera dichas actividades de entrenamiento foráneo como transferencias de tecnología y advierte explícitamente que debe modificarse esa tecnología para adaptarse a las condiciones sociales, económicas, culturales y técnicas existentes y a las tradiciones del país anfitrión.

El trabajo sostiene que la tecnología modificada utilizada en programas locales de entrenamiento no está disponible fácilmente en el mercado mundial. En consecuencia, muchos países en desarrollo se ven forzados a contratar consultores extranjeros para que vuelvan a desarrollar totalmente los medios auxiliares y material de entrenamiento que ya existen en otros lu-

gares. Una actitud más generosa dirigida a compartir la información que existe sobre entrenamiento entre países en desarrollo y entre instructores especializados, ayudaría a reducir esta continua y reiterada invención de la rueda.

El texto proporciona una revisión general de los problemas que se encuentran durante la implementación de un programa de entrenamiento en un país en desarrollo y sugiere las causas y/o soluciones. También sugiere que el entrenamiento de personal adiestrado para cargos supervisores de más alta calidad, que es generalmente un esfuerzo a largo plazo, puede consistir de períodos cortos de entrenamiento formal en un centro de entrenamiento, entremezclado con períodos más largos de entrenamiento práctico en el trabajo.

El segundo texto, *Road Maintenance Training—The Work of a Specialist Organization* (Entrenamiento en conservación vial—El trabajo de una organización especializada), es otro trabajo presentado en la

partie, dans un ou plusieurs centres spécialement conçus à cet effet et sous la conduite d'instructeurs professionnels. Pour les activités de formation qui ne sont requises dans chaque pays que pour un petit nombre d'employés spécialisés, on suggère un programme régional, c'est-à-dire l'utilisation d'un seul centre de formation pour plusieurs pays afin de réduire les frais. On présume que la formation initiale sera donnée par des étrangers jusqu'à ce que les instructeurs locaux soient préparés. On compare ces activités de formation venant de l'étranger à un transfert de technologie, et on avertit de façon explicite de ce que cette technologie doit être modifiée afin de correspondre aux conditions sociales, économiques, culturelles et techniques, ainsi qu'aux traditions de chaque pays.

On affirme dans cette communication que la technologie modifiée pour les besoins des pro-

grammes locaux de formation ne peut pas s'acquérir directement sur le marché mondial. C'est pourquoi de nombreux pays en voie de développement sont forcés d'engager des experts conseil étrangers pour redévelopper entièrement le matériel auxiliaire ainsi que le matériel déjà en usage dans d'autres pays. Une attitude plus ouverte entre les pays en voie de développement et entre les instructeurs professionnels, en ce qui concerne la diffusion de l'information, contribuerait à réduire cette réinvention continue de la roue.

Le texte passe en revue d'une manière assez générale les problèmes qui se posent lors de la mise en oeuvre d'un programme de formation dans les pays en voie de développement et suggère certaines causes et/ou solutions. Il propose également que la formation de personnel spécialisé pour occuper des postes de contremaîtres plus qualifiés peut consister, au

another paper presented at the Pan African Conference on Highway Maintenance and Rehabilitation in Ghana (United Nations Economic Commission for Africa, 1977). It describes the training services provided to various African countries by an organization of professional trainers. The training described involves both training centers and TPUs. These training approaches use experienced foreign personnel as instructors while, at the same time, they prepare counterpart instructors to continue the training program when the training contract expires.

The text outlines the group's approach to maintenance-training projects from initial survey through implementation and evaluation. Each project begins with a survey of in-country educational and training institutions, productive personnel available, and organizational data of the Roads Department — e.g., organizational chart and job descriptions, on-hand and proposed equipment, and current training facilities and teaching resources. The survey report relates skilled labor needs to available labor skills and outlines an operations plan for a training pro-

Conferencia Pan-Africana sobre Conservación y Rehabilitación de Carreteras en Ghana (Comisión Económica de las Naciones Unidas para el Africa, 1977). Describe los servicios de entrenamiento proporcionados a varios países africanos por una organización de instructores profesionales. El entrenamiento descrito incluye tanto los centros de entrenamiento como las unidades de producción de entrenamiento. Estos sistemas de entrenamiento emplean como instructores a personal extranjero experimentado mientras que, al mismo tiempo, preparan instructores de la contraparte local para continuar con el programa cuando termine el contrato de entrenamiento.

El texto delinea los sistemas utilizados por el grupo para proyectos de entrenamiento en conservación, desde los estudios iniciales hasta su implementación y evaluación. Cada proyecto

comienza con un estudio de las instituciones educacionales y de entrenamiento en el país, personal productivo disponible y gastos de organización del Departamento de Carreteras — por ejemplo, cuadro de organización y descripción de la obra, equipo disponible y propuesto, y actuales medios de entrenamiento y recursos de enseñanza. El informe relaciona las necesidades de mano de obra especializada con la disponibilidad de ella y delinea un plan de operaciones para un programa de entrenamiento que satisfaga esas necesidades. Se prepara entonces un informe de la programación final que contiene un detallado plan de operaciones. Este informe, que incluye horarios, logística y presupuesto, llega a ser la base de un contrato para implementar el esfuerzo en entrenamiento.

La evaluación del proyecto es una actividad continúa durante todo el período del contrato.

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lieu du programme de longue haleine habituel, de courtes périodes de formation dans un centre à cet effet, séparées par des périodes plus longues d'apprentissage pratique sur le tas.

Le second texte, *Road Maintenance Training — The Work of a Specialist Organization* (La formation technique pour l'entretien des routes — La tâche d'un organisme de spécialistes), fut également présenté à la Pan African Conference on Highway Maintenance and Rehabilitation au Ghana (United Nations Economic Commission for Africa, 1977). Il décrit les services de formation technique offerts aux divers pays africains par un organisme d'instructeurs professionnels. Le programme présenté comprend des centres de formation ainsi que des unités productives de formation. Dans ces deux systèmes, on emploie du personnel étranger expérimenté comme instructeurs et, en même temps, on prépare des instructeurs locaux pour continuer le programme de formation à l'expiration du contrat.

Dans cette communication, on insiste sur la participation en groupe aux projets de formation

pour l'entretien, depuis l'étude initiale du terrain jusqu'à l'exécution et l'évaluation du travail. Chaque projet commence par une étude des instituts d'éducation et de formation du pays, du personnel productif disponible, et des informations sur le département des routes, telles que l'organigramme et la description des emplois, le matériel disponible et futur, les installations de formation actuelles et les ressources pour l'enseignement. Le compte rendu de cette étude compare le besoin de personnel qualifié à la main-d'oeuvre actuelle et donne les grandes lignes d'un plan d'action pour l'élaboration d'un programme de formation technique qui permettrait de satisfaire ce besoin. Un dernier rapport, contenant un plan d'action détaillé, est alors rédigé. Il comprend programmes, logistique et budgets, et devient la base du contrat pour l'initiation d'un effort de formation.

L'évaluation du projet constitue une tâche continue tout au long de la période du contrat. Chaque stagiaire est évalué au cours de sa formation et après. Les instructeurs en formation sont aussi évalués périodiquement afin de dé-

gram to satisfy those needs. A final programming report, which contains a detailed plan of operations, is then prepared. This report, including timetables, logistics, and budget, becomes the basis for a contract to implement the training effort.

Project evaluation is a continuing activity throughout the contract period. Individual trainees are evaluated throughout their training and after their training is completed. The counterpart instructors are also evaluated periodically to determine when they can replace the foreign trainers.

The paper concludes with a section that deals

with the lessons learned by the training organization during its various training projects and recommends ways of making training for road-maintenance personnel more effective. This evaluation concludes that there are two distinct training methodologies based either on a large, fixed training center or on mobile TPUs. It suggests that most future programs will likely be a combination of training centers and TPUs.

The third text, *Principal Findings of Training Research*, a paper presented at the Michigan Management Seminar (1978), discusses the training of large decentralized employee forces and is limited to training rather than educational

Se evalúan a los participantes individuales durante su entrenamiento y después de terminar su preparación. También se evalúan periódicamente a los instructores de la contraparte local para determinar el momento en que estén en condiciones de reemplazar a los instructores extranjeros.

El trabajo concluye con una sección que se ocupa de las lecciones aprendidas por la organización de entrenamiento durante los diversos proyectos y recomienda medidas para hacer más efectivo el entrenamiento del personal de conservación vial. Esta evaluación concluye en que hay dos diferentes metodologías de entrenamiento basadas sea en un centro fijo y grande de entrenamiento o en unidades móviles de producción de entrenamiento. Ello sugiere de que la mayor parte de los programas futuros será probablemente una combinación de centros de entrenamiento y de unidades de producción de entrenamiento.

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El tercer texto, un trabajo titulado *Principal Findings of Training Research* (Descubrimientos principales en investigación de entrenamiento) presentado al Seminario sobre Administración de Michigan (1978), analiza el entrenamiento de grandes grupos de empleados descentralizados y está limitado más a las necesidades de entrenamiento que a las educacionales. Sostiene que sólo existen dos opciones viables para entrenar grandes grupos: (a) entrenar primero a los supervisores y dejar que ellos entrenen luego a sus empleados, o (b) entrenar directamente a los empleados utilizando instructores especiales. La primera requiere preparar con anticipación los materiales para entrenamiento. De ese modo, un gran número de supervisores trabajando separadamente en varias localidades pueden obtener resultados razonablemente uniformes.

El trabajo subdivide la función de entrenamiento en tres actividades principales. La pri-

terminer quand ils peuvent remplacer les instructeurs étrangers.

L'exposé se termine par une section qui traite des leçons apprises par l'organisme instructeur au cours de ses divers projets de formation et recommande plusieurs moyens pour augmenter l'efficacité du programme de formation du personnel d'entretien des routes. Cette évaluation conclut qu'il existe deux méthodes différentes de formation, l'une basée sur un grand centre fixe d'enseignement, l'autre sur des unités productives mobiles de formation. Elle suggère que la plupart des programmes futurs seront probablement une combinaison de centres et d'unités productives de formation.

Le troisième texte, un travail intitulé *Principal Findings of Training Research* (Principales découvertes de la recherche sur la formation), présenté au Michigan Management Seminar (1978),

traite de la formation d'un important groupe décentralisé d'employés et se limite à la formation plutôt qu'à l'éducation. Il affirme qu'il n'existe que deux options valables pour instruire d'importants groupes: (a) former d'abord les contremaîtres et les laisser instruire leurs employés, ou (b) former directement les employés en utilisant des instructeurs spéciaux. Pour la première méthode un matériel didactique tout préparé est nécessaire. Ainsi, de nombreux contremaîtres travaillant indépendamment à divers endroits peuvent obtenir des résultats assez uniformes.

Dans cet exposé, la fonction de formation est subdivisée en trois activités principales. La première, développement de méthodes et systèmes, comprend la définition des méthodes de travail et des systèmes d'administration standards à enseigner. Ceux-ci doivent être déterminés par les fonctionnaires du département

needs. It contends that only two viable options for training large groups exist: (a) train the supervisors first and let them train their employees, or (b) train the employees directly by using special instructors. The first method requires that the training materials be prepackaged. Thus, large numbers of supervisors working separately in various locations can obtain reasonably uniform training results.

The paper subdivides the training function into three major activities. The first, methods and systems development, involves the determination of the standard work methods and management systems to be taught. These must be decided by the operating officials of the highway department who are accountable for completing work loads within given time frames and approved budgets. Otherwise, the training will not be properly focused on the desired results.

mera, desarrollo de métodos y sistemas, involucra la determinación de los métodos normales de trabajo y de los sistemas administrativos que se enseñarán. Estos deben ser definidos por los funcionarios operativos del departamento de carreteras, que tienen la responsabilidad de completar las cargas de trabajo dentro de límites de tiempo dados y presupuestos aprobados. De no ser así, el entrenamiento no estará centrado adecuadamente para obtener los resultados deseados.

La segunda actividad, diseño y producción del curso es ejecutada mejor por especialistas en entrenamiento que conocen las interioridades de las técnicas de entrenamiento. Debe

des routes responsables de la réalisation d'un certain volume de travail en un certain temps et dans les limites du budget. Sans quoi, la formation ne pourra être centrée correctement sur les résultats désirés.

La seconde activité, conception et production du cours, est du ressort de spécialistes en formation technique, qui connaissent la complexité des techniques de formation. Ils devraient pouvoir concevoir et élaborer les cours sans intervention des fonctionnaires. L'apport de ces derniers à cette activité devrait se limiter aux considérations de politique et de priorité sans entrer dans les techniques de formation.

Les fonctionnaires responsables ou des instructeurs spécialisés, tels que des opérateurs de matériel lourd instruits et expérimentés, se chargeraient de la troisième activité, la mise en oeuvre du programme. Après avoir approuvé les cours et plans d'études présentés par les

The second activity, course design and production, is best carried out by training specialists who are knowledgeable about the intricacies of training techniques. These specialists should be allowed to develop the course design and production activities with no interference from the operating officials. The latter's input to this activity should be limited to policy and priority considerations rather than training techniques.

The third activity, training implementation, should be carried out by the operating officials or by specialized instructors, e.g., experienced, trained equipment operators. After the supervisors have approved the draft courses and curriculums prepared by the training specialists, they (a) should determine individual training needs; (b) should schedule and, whenever possible, should conduct the training; and (c) should evaluate performance results. This

permitirse que estos especialistas desarrollen las actividades de diseño y producción del curso, sin interferencias de los funcionarios operativos. La última entrada a esta actividad deberá estar limitada a consideraciones de política y prioridades más que a las técnicas de entrenamiento.

La tercera actividad, implementación del entrenamiento, debe estar a cargo de los funcionarios operativos o de instructores especializados; por ejemplo, operadores de equipo experimentados y entrenados. Luego de que los supervisores han aprobado los borradores de los cursos y los planes de estudios preparados por los especialistas en entrenamiento, deben (a) de-

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spécialistes en formation technique, ils doivent: (a) définir la formation nécessaire à chaque individu; (b) programmer et, dans la mesure du possible, diriger la formation; et (c) évaluer les résultats. Cette méthode donne aux responsables le contrôle d'un instrument de direction qui leur est nécessaire pour remplir les conditions de volume de travail, de temps et de budget sous lesquelles ils doivent opérer.

Cet exposé indique que le succès de la formation en tant que système qui emploie des programmes tout préparés et des contremaîtres comme instructeurs, est dû à deux raisons. Premièrement, ayant participé au développement du programme les contremaîtres le défendront; ils peuvent décider de former les employés qui en ont besoin lorsque c'est nécessaire, quand le volume de travail le permet, et lorsque les tâches se rapportent aux méthodes enseignées.

method gives the responsible parties control of a management tool that they need in order to efficiently meet the work load, time, and budget requirements under which they must operate.

The paper indicates that the systems approach, which uses packaged training programs and supervisors as instructors, is successful for two reasons. First, the operating supervisors will support the training program because they were instrumental in developing it, they can schedule training for employees requiring it when needed, when work loads will permit it, and then they can follow up the training with proper work assignments. Second, the trainees will be much more serious about training if it is con-

ducted by their supervisors rather than by someone else.

The paper concludes that, although operating supervisors generally make poor educators, they can make good instructors. This can be accomplished, though, only if the instructor role is properly defined, if instructor materials are provided, and if instructional training is provided.

The principles described in this paper are incorporated into the training program described in the next text.

The fourth text is excerpted from *Training Support Services* (Direktorat Jenderal Bina Marga, Government of Indonesia, 1975). It is the

terminar las necesidades de entrenamiento individual; (b) programar, y siempre que sea posible, conducir el entrenamiento; y (c) evaluar los resultados de la actuación. Este método da a las partes responsables el control de una herramienta administrativa que necesitan para satisfacer de manera eficiente la carga de trabajo, el tiempo y los requerimientos presupuestales bajo los cuales debe operar.

El trabajo indica que los sistemas que usan programas de entrenamiento previamente preparados y emplean a supervisores como instructores tienen éxito por dos razones. Primero, los supervisores de servicio apoyarán el programa de entrenamiento debido a que participaron en su desarrollo; pueden programar el entrenamiento de los empleados que lo necesitan, cuando lo necesitan, cuando lo permitan las cargas de trabajo, y cuando puedan seguir el entrenamiento con las asignaciones adecuadas de trabajo. Segundo, los participantes tomarán

más en serio el entrenamiento si éste está a cargo de sus supervisores en lugar de otras personas.

El trabajo concluye indicando que aunque los supervisores de servicio son por lo general pobres educadores, pueden llegar a ser buenos instructores. Y sólo puede lograrse si se define apropiadamente el rol del instructor y se proporcionan los materiales de instrucción y el respectivo entrenamiento instructivo.

Los principios descritos en este trabajo se incorporan al programa de entrenamiento descritos en el siguiente texto.

El cuarto texto ha sido extractado de *Training Support Services* (Servicios de apoyo al entrenamiento) (Direktorat Jenderal Bina Marga, Gobierno de Indonesia, 1975). Es el informe final de un proyecto ejecutado por el Gobierno de Indonesia y dos grupos consultores — Roy Jorgensen Associates, Inc., y BCEOM (Bureau Central pour les Equipements d'Outre-Mer) — para

Deuxièmement, les stagiaires prendront le programme beaucoup plus au sérieux s'il est donné par leur contremaître plutôt que par quelqu'un d'autre.

En conclusion, bien que les contremaîtres soient souvent des éducateurs médiocres, ils font cependant de bons instructeurs si on définit clairement leur rôle, si on leur fournit le matériel didactique, et à condition d'avoir été bien préparés pour ce rôle.

Les principes énoncés dans cette communication sont incorporés au programme de formation décrit dans le texte suivant.

Le quatrième texte est extrait de *Training Support Services* (Services d'aide à la formation technique, Direktorat Jenderal Bina Marga, Gouvernement d'Indonésie, 1975). C'est le rapport final d'un projet entrepris par le

Gouvernement Indonésien et par deux groupes d'experts conseil — Roy Jorgensen Associates, Inc., et le Bureau Central pour les Equipements d'Outre-Mer (BCEOM) — pour développer un programme de formation destiné au personnel routier employé au niveau national et au niveau provincial.

Le programme de formation technique considère les organismes routiers actuels de Bina Marga et les départements provinciaux des travaux publics comme responsables de l'opération du réseau, des méthodes de travail, de la demande de main-d'oeuvre, des systèmes de gestion, et de la formation des employés. Une unité centrale de formation à Bina Marga est chargée de la conception et de la production des programmes. L'objectif principal du projet, objet de ce rapport, était de former un groupe

final report of a project undertaken by the Indonesian government and two consultant groups — Roy Jorgensen Associates, Inc., and Bureau Central pour les Equipements d'Outre-Mer (BCEOM) — to develop a training program for highway personnel employed at both the national and the provincial levels.

The training program places responsibility for highway operations, work methods, workmanship requirements, management systems, and actual employee training in the operating organization of Bina Marga and the provincial public works departments. It places responsibility for designing and producing training programs in a central training unit in Bina Marga. The principal objective of the project reported on was to develop a central training unit staff capable of designing and producing training programs and to develop provincial training officers capable of implementing the resulting programs.

desarrollar un programa de entrenamiento para el personal de carreteras empleado tanto a nivel nacional como provincial.

El programa de entrenamiento responsabiliza a las organizaciones operativas de Bina Marga y de los departamentos provinciales de obras públicas, por las operaciones viales, métodos de trabajo, necesidades de mano de obra especializada, sistemas administrativos y entrenamiento efectivo de los empleados. Establece la responsabilidad para diseñar y producir programas de entrenamiento en una unidad central de entrenamiento ubicada en Bina Marga. El objetivo principal del proyecto materia del informe fue desarrollar al personal de una unidad central de entrenamiento capaz de diseñar y producir programas de entrenamiento y desarrollar funcionarios de entrenamiento provincial capaces de implementar los programas resultantes.

En este programa, un panel técnico que re-

central de spécialistes en formation technique, qui puissent concevoir et élaborer les programmes d'apprentissage, ainsi que des fonctionnaires provinciaux capables de mettre en oeuvre les programmes résultants.

Au cours de ce projet, une commission technique représentant le conseil d'administration en fonction à Bina Marga développa des méthodes et conditions de travail standards. Les contremaîtres présents aux conseils d'administration de Birna Marga et aux départements provinciaux des travaux publics dirigent la formation technique. Ils ne sont sensés utiliser les cours que lorsque cela

In this program, a technical panel representing the operating directorates of Bina Marga developed standard work methods and requirements. The operating supervisors in the Bina Marga directorates and the provincial public works departments conduct the training. The supervisors are expected to use the courses only when they would obtain better work-performance results, or faster results.

Standard engineering practices developed in other countries and training courses available from other highway agencies were used as guides for developing work methods. These were altered as necessary to recognize equipment limitations in Indonesia or local materials availability. Work methods were defined in two forms: (a) Course Designs, whenever standard practices elsewhere were adopted with only minor changes; and (b) Road Notes (recommended engineering practices), whenever it was

presentaba a la dirección operativa de Bina Marga desarrolló los métodos y requerimientos normales de trabajo. Los supervisores operativos de las direcciones de Bina Marga y de los departamentos provinciales de obras públicas conducen el entrenamiento. Se espera que los supervisores usen sólo los cursos cuando obtengan mejores resultados en la ejecución de los trabajos, o resultados más rápidos.

Los métodos normales de ingeniería desarrollados en otros países y los cursos de entrenamiento disponibles en otros organismos de carreteras fueron utilizados como guías para desarrollar los métodos de trabajo empleados. Estos fueron alterados lo suficiente para tomar en cuenta las limitaciones de equipo en Indonesia o la disponibilidad de materiales locales. Se definieron de dos maneras los métodos de trabajo: (a) Diseños de cursos siempre que se adoptaron métodos normales de otros lugares

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permet d'améliorer les résultats ou d'augmenter le rendement du travail.

Des méthodes de construction standards développées à l'étranger et les cours de formation technique d'autres organismes routiers servent de guide à l'élaboration des méthodes de travail. Celles-ci furent modifiées en tenant compte des limitations de matériel en Indonésie, ainsi que des matériaux locaux disponibles. On définit deux sortes de méthodes: (a) Elaboration de Cours, lorsque des méthodes standards étrangères étaient adoptées avec seulement quelques changements peu importants; et (b) Notes de

necessary to create original work methods or to make radical changes in practices elsewhere.

Courses are designed in series to prevent duplication. The subject matter of most courses is limited to single work assignments. Therefore, most employees can take the training they need without taking unnecessary courses. Various combinations of courses can be put together for training different types of crews.

The text presents a detailed review of the training organization, work-methods development, training-course production, and program implementation of one of the largest training objectives ever attempted — 40,000 persons employed by 27 separate government agencies.

The fifth text, *Methods Employed in Conducting a Training Needs Study in a Maintenance Division of a State Highway Department*, appeared in *Highway Research Record 241* (Highway Research Board, 1968). It presents a technique that can be used to identify the training needs of highway-maintenance supervisors and to develop a plan for training those supervisors. Similar techniques can be used for other highway-employee categories.

The text describes the analysis of the work requirements for maintenance supervisors. The work is subdivided into job elements, which are definable segments of the work performed, and job element tasks, which are units of work per-

con sólo menores cambios; y (b) Anotaciones viales (prácticas recomendadas de ingeniería), siempre que fueran necesarias para crear métodos originales de trabajo o hacer cambios radicales en los sistemas usados en otros lugares.

Se diseñaron los cursos en serie para evitar duplicidad. El tema de la mayoría de los cursos está limitado a asignaciones individuales de trabajo. En consecuencia, la mayoría de los empleados pueden adquirir el entrenamiento que necesitan sin tomar cursos innecesarios. Se pueden reunir varias combinaciones de cursos para entrenar a diferentes tipos de cuadrillas.

El texto presenta una revisión detallada de la organización de entrenamiento, desarrollo de métodos de trabajo, producción de cursos de entrenamiento, e implementación del programa de uno de los mayores objetivos de entrenamiento jamás intentado — 40.000 personas empleadas por 27 organismos gubernamentales separados.

El quinto texto, *Methods Employed in Conducting a Training Needs Study in a Maintenance Division of a State Highway Department* (Métodos empleados para conducir un estudio de necesidades de entrenamiento en una división de conservación de un departamento estatal de carreteras), aparece en *Highway Research Record 241* (Highway Research Board, 1968). Presenta una técnica que puede ser utilizada para identificar las necesidades de entrenamiento de los supervisores de conservación vial y desarrollar un plan para entrenar a dichos supervisores. Se pueden emplear técnicas similares para otras categorías de empleados de carreteras.

El texto describe el análisis de los requerimientos de trabajo para los supervisores de conservación. La obra está subdividida en elementos de trabajo que son segmentos definibles del trabajo ejecutado y, en tareas de elementos de trabajo, que son unidades de

Route (méthodes de construction conseillées), lorsqu'il a été nécessaire de créer des méthodes de travail originales ou d'effectuer des changements radicaux dans les méthodes étrangères.

Les cours sont conçus en série, de manière à éviter les répétitions. Le sujet de la plupart des cours est limité à une seule tâche. Dès lors, les employés peuvent suivre la formation dont ils ont besoin sans prendre de cours inutiles. Les cours peuvent être combinés de plusieurs façons, et servent ainsi à la formation du personnel de différentes équipes.

Dans cette étude on présente un examen détaillé de l'organisation de l'enseignement, du développement des méthodes de travail, de l'élaboration des cours, et de la mise en oeuvre

du programme pour l'un des plus grands projets jamais entrepris — 40.000 personnes employées par 27 agences gouvernementales différentes.

Le cinquième texte, *Methods Employed in Conducting a Training Needs Study in a Maintenance Division of a State Highway Department* (Méthodes employées pour l'étude de la formation nécessaire dans une division d'entretien d'un département routier d'un Etat), a été publié dans *Highway Research Record 241* (Highway Research Board, 1968). Il présente une technique applicable pour déterminer la formation nécessaire aux contremaîtres pour l'entretien des routes, et pour développer un plan ayant pour but de pourvoir à ce besoin. Des techniques semblables peuvent s'appliquer à d'autres catégories d'employés routiers.

formed in connection with a job element. Each task requires the knowledge and ability for its performance, and some tasks require skill, i.e., an exceptional ability with tools or equipment. KSA requirements for each task are identified, defined, and classified. The total series of KSA combinations contains all of the KSAs required to accomplish all of the work being investigated, regardless of the number of persons, levels of authority, or number of organizational units involved.

Individual and potential supervisors are then selected at random to represent, as samples, the personnel included in the described training-needs survey. Tests, evaluations, and appraisals are used to determine the extent to which the sample individuals possess the KSAs needed to perform their assignments. The results are projected to obtain indications of the training needs of the personnel represented by the samples. The identified training needs con-

stitute one set of principal data needed to plan an overall training program.

Other data needed are those that reflect the characteristics and attitudes of the persons to be trained. These data include (a) the age, education, and experience distributions of employees; (b) the relative capacities of employees to absorb training; (c) the prevailing attitudes of employees toward training; and (d) the geographic locations of employees. The final characteristics that influence the design of the training materials are the turnover and force-expansion rates.

The objective of training is to develop the employee's performance capabilities to the level required to do the work. The development of a plan for training involves (a) summarizations of the data described above, (b) analysis and interpretation of the summarized data, and (c) preparation of a framework of policies, specifications, and organizational relations for training.

trabajo ejecutadas en conexión con un elemento de trabajo. Cada tarea requiere de conocimiento y capacidad para ejecutarla, y algunas tareas requieren destreza, esto es, una habilidad excepcional con las herramientas y con el equipo. Se identifican, definen, y clasifican los requerimientos de CDH para cada tarea. La serie total de combinaciones de CDH contiene todos los CDH requeridos para llevar a cabo todo el trabajo bajo investigación, sin tomar en cuenta el número de personas, los niveles de autoridad, o el número de unidades organizativas involucradas.

Se seleccionan entonces al azar a individuos

y supervisores potenciales para representar, como muestras, al personal incluido en el estudio de necesidades de entrenamiento descrito. Las pruebas, evaluaciones, y apreciaciones se emplean para determinar el grado de CDH que los individuos seleccionados como muestras poseen para llevar a cabo sus funciones. Se proyectan los resultados a fin de tener una indicación de las necesidades de entrenamiento del personal representado por las muestras. Las necesidades de entrenamiento identificadas constituyen en juego de la información principal requerida para planificar un programa integral de entrenamiento.

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Dans cette publication, on analyse le travail requis des contremaîtres pour l'entretien, travail qui est subdivisé en plusieurs éléments définis comme des segments déterminés de travail à réaliser et en plusieurs tâches au sein de chaque élément, ou unités de travail ayant rapport à un élément. L'exécution de chaque tâche exige certaines connaissances et capacités, et, dans certains cas, de l'habileté, comme par exemple pour le maniement d'outils ou du matériel. Les KSA requises pour chaque tâche sont identifiées, définies et classifiées. La série complète des combinaisons de KSA contient toutes les KSA nécessaires pour accomplir tout le travail sous étude, indépendamment du nombre de personnes, des niveaux d'autorité, ou du nombre d'unités organisationnelles impliquées.

Plusieurs contremaîtres actuels et futurs sont ensuite choisis au hasard afin d'obtenir un

échantillonnage du personnel considéré dans l'enquête sur le besoin de formation. Au moyen de tests, évaluations et estimations, on détermine jusqu'à quel point les individus sélectionnés possèdent les KSA nécessaires pour réaliser leur travail. Les résultats sont projetés dans le but d'obtenir certaines indications sur la formation nécessaire au personnel représenté par l'échantillon. Les besoins indiqués constituent une partie importante de l'information nécessaire pour élaborer un programme général de formation.

Il est également nécessaire de réunir l'information qui reflète les caractéristiques et l'attitude des personnes qui recevront une formation. Ces données incluent: (a) la distribution d'âge, du niveau d'instruction, et d'expérience entre les employés; (b) la capacité relative des employés à absorber la formation; (c) l'attitude prédomi-

The text evaluates all of these factors.

The sixth text is excerpted from *Managing Highway Maintenance in Virginia*, which is Part IV of the final report of the Virginia Maintenance Study (Virginia Department of Highways, 1966). It describes the development of a performance-oriented training program for use by line supervisors in training their employees. This type of program attempts to develop training activities to rectify specific performance problems. Because the training is task-oriented, training needs are determined by (a) isolating the specific causes of substandard performance, (b) classifying the problems as representing a training need or subject to a less-expensive management solution, (c) identifying those employees who need training, and (d) identifying developmental training needs as well as specific problem-oriented needs. Case

examples are used to illustrate each consideration.

The development of training materials specifically related to a defined problem includes (a) developing the subject matter, i.e., gathering the information needed for the preparation of materials; (b) selecting the training method to be used; and (c) developing the actual training materials, including text and illustrations, in a form suitable for use by line personnel. Materials related to the basic KSAs needed to perform the work, i.e., mathematics, record keeping, and safety requirements, are included in the specific training areas in the described performance-oriented training programs. This material would normally be included as a separate training activity in a training program that is subject-matter-oriented.

The text draws these conclusions about the

Otra información necesaria es aquella que refleja las características y actitudes de las personas a entrenar. Esta información incluye (a) la distribución de los empleados por edad, educación y experiencia; (b) las capacidades relativas de los empleados para absorber el entrenamiento; (c) las actitudes prevalecientes de los empleados hacia el entrenamiento; y (d) las ubicaciones geográficas de los empleados. Las características finales que influyen en el diseño de los materiales de entrenamiento son las tasas de rendimiento y de expansión de energía.

El objetivo del entrenamiento es desarrollar la capacidad de ejecución del empleado al nivel requerido para hacer el trabajo. El desarrollo de un plan para entrenamiento comprende (a) resumen de la información descrita anteriormente, (b) análisis e interpretación de la información resumida, y (c) preparación de un marco de políticas, especificaciones y relaciones organizativas para entrenamiento. El texto evalúa todos estos factores.

El sexto texto ha sido extractado de *Manag-*

ing Highway Maintenance in Virginia (Administrando la conservación vial en Virginia), que es la parte IV del informe final del Virginia Maintenance Study (Departamento de Carreteras de Virginia, 1966). Describe el desarrollo de un programa de entrenamiento orientado a la ejecución a ser utilizado por los supervisores de línea para el entrenamiento de sus empleados. Este tipo de programa intenta desarrollar actividades de entrenamiento para rectificar problemas específicos de ejecución. Debido a que el entrenamiento está orientado a las tareas, se determinan las necesidades de entrenamiento (a) aislando las causas específicas de rendimientos subnormales, (b) clasificando los problemas como que representan una necesidad de entrenamiento o sujetas a una solución administrativa costosa, (c) identificando a los empleados que necesitan entrenamiento, y (d) identificando las necesidades orientadas a problemas específicos. Se emplean ejemplos típicos para ilustrar cada caso.

El desarrollo de materiales de entrenamiento

nante des employés envers un programme de formation; et (d) leur disposition géographique. Enfin, les dernières caractéristiques qui influencent l'élection du matériel de formation sont le taux de défection ou d'expansion de la main-d'oeuvre.

Un programme de formation vise à développer les capacités des employés jusqu'au niveau nécessaire pour réaliser correctement leur travail. Son élaboration requiert: (a) un résumé de l'information décrite ci-dessus; (b) l'analyse et l'interprétation de ce résumé; et (c) la prépara-

tion d'un système de règlements, spécifications et relations organisationnelles pour la formation. Le texte en question évalue tous ces facteurs.

Le sixième texte est extrait de *Managing Highway Maintenance in Virginia* (Administration de l'entretien des routes en Virginie), IV^{ème} Partie du rapport final de la Virginia Maintenance Study (Etude sur l'entretien des routes en Virginie, Virginia Department of Highways, 1966). Il décrit la préparation d'un programme de formation basé sur la réalisation du travail, à l'usage des contremaîtres qui instruisent leurs employés. Ce

use of training materials developed in this program.

1. Needed practical information provided in usable form enables line supervisors to become satisfactory instructors.

2. Each supervisor must be trained and motivated by his immediate supervisor before he can train and motivate his subordinates.

3. Many maintenance employees have difficulty with the manipulation of numbers.

4. Better participation is obtained when the group of trainees is small and knows each other.

5. Systematic and thorough pre-training and preparation of instructors is imperative, regardless of the level or degree of informality with which the training is conducted.

Although the training program described in this text is problem-oriented, the basic developmental steps and case studies presented con-

tain the same basic principles involved in preparing a subject-matter-oriented training program. The relation between the subject-matter specialist (the operating official) and the training specialist is the same. The principles that the production supervisors maintain control of training activities and that downward training occur through supervisory levels also remain the same. The major difference between problem-oriented and subject-matter-oriented training programs is the inclusion of some basic KSA information in performance-oriented training rather than a consideration of basic KSAs as prerequisite training, which is normally the case in subject-matter-oriented training.

The seventh text is excerpted from the *Handbook on Training for Road Departments* (National Association of County Engineers, Training Guide Series, 1974). It is addressed to the head

relacionados específicamente a un problema definido incluye (a) desarrollo del tema en estudio, por ejemplo, recolección de la información necesaria para la preparación de los materiales; (b) selección del método de entrenamiento a utilizar; y (c) desarrollo de los materiales de entrenamiento propiamente dichos, incluyendo textos e ilustraciones, en una manera conveniente para su empleo por el personal de línea. Los materiales relacionados con los CDH básicos requeridos para ejecutar el trabajo, éste es, matemáticas, archivo y requerimientos de seguridad, están incluidos en las áreas específicas de entrenamiento de los programas descritos de entrenamiento orientado a la ejecución. Este material deberá estar incluido normalmente como una actividad separada de entrenamiento en un programa de entrenamiento orientado a un determinado tema.

El texto deduce las siguientes conclusiones sobre el uso de materiales de entrenamiento desarrollados en este programa.

1. La información práctica necesaria proporcionada en forma utilizable permite que los supervisores de línea lleguen a ser instructores satisfactorios.

2. Cada supervisor debe estar entrenado y motivado por su supervisor inmediato antes de que pueda entrenar y motivar a sus subordinados.

3. Muchos empleados de conservación tienen dificultades con el manejo de números.

4. Se obtiene una mejor participación cuando el grupo de participantes es pequeño y se conocen entre ellos.

5. Es imperativo el entrenamiento previo y la preparación sistemática e integral de los instructores, sin tomar en cuenta el nivel o grado de in-

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genre de programme a pour but de fournir un apprentissage qui rectifie certains problèmes spécifiques dans l'exécution des tâches. Etant donné que la formation se rapporte directement au travail, pour déterminer quel enseignement est nécessaire, (a) on isole les causes spécifiques d'un travail médiocre, (b) on classe les problèmes selon qu'ils requièrent un effort de formation ou qu'ils peuvent être résolus par un moyen moins coûteux, (c) on détermine quels employés ont besoin d'un apprentissage, et (d) on identifie quel enseignement servira à développer les connaissances et lequel traitera directement des problèmes spécifiques. Des exemples réels servent à illustrer chaque cas.

L'élaboration d'un matériel didactique en rela-

tion directe avec un certain problème comprend: (a) le développement du sujet étudié, par exemple en réunissant l'information nécessaire à la préparation du matériel; (b) le choix de la méthode de formation à appliquer; et (c) la préparation du matériel didactique final, y compris les textes et illustrations, sous une forme facilement utilisable par le personnel. Le matériel ayant rapport aux KSA de base nécessaires pour réaliser le travail, par exemple les mathématiques, tenue des comptes rendus, et les normes de sécurité, est inclus dans chaque branche des programmes portant sur le travail réalisé. Dans un programme basé sur un sujet déterminé, cette matière serait normalement considérée comme une branche séparée.

of a state, city, town, or county road department and presents information about employee training to increase productivity and efficiency. The previous selected texts treat training in the formal context by using specialists in work methods and training techniques to develop training programs. However, this text treats training as a personnel management tool to be used by a responsible supervisor. The techniques are basically the same as those used in the previous texts, but the training program operates on a smaller scale. Although some of the steps are less formal than those previously described, the text is included in Compendium 14 to show that training is a viable management tool for a small road organization with a limited budget and a minimum of outside expertise. This text examines the reasoning, planning, and execution of a training program from the viewpoint of an indi-

vidual supervisor and is, therefore, a much more personal and less formidable presentation.

The eighth text, *Trainer's Guide* (National Association of County Engineers, Training Guide Series, 1974), is designed to accompany the previous text. While that text provides the road department head with information about training for foremen and crews, the *Trainer's Guide* offers information for the trainer on how to train foremen and crews. It can serve professional trainers in the preparation of training programs or in the presentation of training sessions at a training center, as well as supervisors training their own crews.

The text divides the training activity into three phases. The first phase is advanced planning, which gives the trainer a chance to review material and to revise the training program as needed. This phase also includes making ar-

formalidad con que se conduce el entrenamiento.

Aunque el programa de entrenamiento descrito en este texto es orientado al problema, los pasos básicos de desarrollo y los estudios típicos presentados contienen los mismos principios básicos involucrados en la preparación de un programa de entrenamiento orientado a un aspecto definido. La relación entre los especialistas en determinados aspectos (el funcionario operativo) y el especialista en entrenamiento es la misma. Los principios de que los supervisores de producción mantienen el control de las actividades de entrenamiento y de que ocurre una disminución del nivel de entrenamiento a través de los niveles de supervisión, también permanecen iguales. La principal diferencia entre los programas de entrenamiento orientados a un

problema y los orientados a un tema es la inclusión de alguna información CDH básica en el entrenamiento orientado a la ejecución, en lugar de considerar los CDH básicos como un prerrequisito de entrenamiento, que es normalmente el caso en un entrenamiento orientado a un determinado aspecto.

El séptimo texto ha sido extractado del *Handbook on Training for Road Departments* (Manual de entrenamiento para departamentos de carreteras) (National Association of County Engineers, Training Guide Series, 1974). Está dirigido a los jefes del departamento vial del estado, de la ciudad, del pueblo o de la provincia y presenta información sobre entrenamiento de los empleados para aumentar la productividad y eficiencia. Los textos seleccionados previamente tratan el entrenamiento en su contexto

Le texte tire les conclusions suivantes sur l'usage du matériel didactique obtenu dans ce programme.

1. Les informations pratiques utiles qui sont présentées de façon claire permettent aux contremaîtres de se transformer en de bons instructeurs.

2. Chaque contremaître doit être formé et motivé par son supérieur immédiat avant de pouvoir former et motiver ses subalternes.

3. De nombreux employés à l'entretien des routes éprouvent des difficultés à manipuler des chiffres.

4. On obtient une meilleure participation lorsque le groupe de stagiaires est réduit et lorsqu'ils se connaissent l'un l'autre.

5. Il est absolument nécessaire de former et de préparer préalablement les instructeurs, de façon systématique et consciencieuse, quel que soit le niveau ou le degré de formalisme des cours qu'ils seront appelés à donner.

Même si le programme de formation décrit dans cette étude se rapporte directement aux problèmes, le développement de base et les exemples pratiques présentés contiennent les mêmes principes fondamentaux qu'un programme de formation basé sur un sujet déterminé. La relation entre le spécialiste de la matière étudiée (le fonctionnaire responsable) et l'expert en formation technique est la même. Restent également semblables les principes selon lesquels les contremaîtres maintiennent les

rangements for training aids and materials. The second phase, preparing for training, involves learning the names, work assignments, and current skills and areas of strength and weakness of each trainee, i.e., knowing each trainee as an individual. The third phase is the actual training, which basically consists of covering the topic

thoroughly. These phases are described in a series of tips or suggestions designed to help a person become an effective trainer.

The ninth text, *Appraising Results Derived from a Maintenance Training Program*, also appeared in *Highway Research Record 241* (Highway Research Board, 1968). It describes

formal usando especialistas en métodos de trabajo y en técnicas de entrenamiento para desarrollar programas de entrenamiento. Sin embargo, este texto trata el entrenamiento como una herramienta para la administración de personal a ser utilizada por un supervisor responsable. Las técnicas son básicamente las mismas que las empleadas en los textos anteriores, pero el programa de entrenamiento opera en una escala menor. Aunque algunos de los pasos son menos formales que los descritos previamente, el texto está incluido en el Compendio 14 para mostrar que el entrenamiento es una herramienta administrativa viable para una administración pequeña de carreteras, con un presupuesto limitado y un mínimo de expertos externos. Este texto examina el razonamiento, planeamiento y ejecución de un programa de entrenamiento desde el punto de vista de un supervisor individual y es, en consecuencia, una presentación mucho más personal y menos ambiciosa.

El octavo texto, *Trainer's Guide* (Guía del instructor) (National Association of County Engineers, Training Guide Series, 1974), está diseñado para acompañar el texto anterior. Mientras que aquél proporciona al jefe del departamento vial información sobre el entrenamiento a los capataces y a las cuadrillas, la *Guía del Instructor* ofrece información al instructor sobre la forma de entrenar a los capataces y al personal de las cuadrillas. Puede servir a los instructores profesionales para la preparación de programas de entrenamiento o para la presentación de sesiones en un centro de entrenamiento, así como a los supervisores para entrenar a sus propias cuadrillas.

El texto divide la actividad de entrenamiento en tres fases. La primera fase es sobre planeamiento avanzado, que dá al instructor una oportunidad de revisar el material y el programa de entrenamiento según se requiera. Esta fase también incluye hacer arreglos para obtener los medios auxiliares y los materiales de entrena-

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activités de formation sour contrôle et la formation du haut de l'échelle vers le bas a lieu en passant par les différents niveaux d'autorité. La différence la plus importante entre les deux types de programme réside dans l'inclusion de certaines informations de KSA de base dans la formation ayant trait au travail à réaliser, plutôt que de les considérer comme nécessaires préalablement à la formation comme c'est normalement le cas dans les programmes basés sur un certain sujet.

Le septième texte est extrait du *Handbook on Training for Road Departments* (Manuel d'entretien à l'usage des départements des routes, National Association of County Engineers Training Guide Series, 1974). Il s'adresse au directeur d'un département des routes de l'état, d'une ville, d'un village ou d'un district, et fournit certaines informations sur la formation nécessaire aux employés afin d'accroître leur productivité et leur efficience. Les textes antérieurs considéraient la formation dans un contexte élaboré, utilisant des spécialistes des méthodes de travail et des techniques spéciales pour développer les

programmes de formation. Le présent document, par contre, traite la formation comme un outil pour la direction du personnel, à l'usage des supérieurs responsables. Les techniques sont fondamentalement les mêmes que celles des textes antérieurs, mais le programme opère à plus petite échelle. Bien que certaines parties soient moins élaborées que celles décrites antérieurement, ce document est inclus dans le Recueil 14 pour montrer que la formation est un instrument de gestion valable pour un petit organisme routier qui ne dispose que d'un budget limité et d'un minimum d'aide d'experts étrangers. Il examine la conception, la planification et l'exécution d'un programme de formation du point de vue individuel du contremaître, et consiste de ce fait en une oeuvre beaucoup plus personnelle et restreinte.

Le huitième texte, *Trainer's Guide* (Guide de l'instructeur, National Association of County Engineers Training Guide Series, 1974), est conçu pour accompagner l'étude précédente. Celle-ci fournit au chef du département des informations sur la formation technique des conducteurs de

an appraisal by the Ontario Department of Highways of the use of a training program on snow-and-ice control similar to the Virginia program described in Selected Text 6. The major part of the program consisted of an illustrated training aid in the form of a flip chart. The program was prepared by a committee of experts and used for training by various tiers of supervisors in accordance with the principles outlined in Selected Text 3. It was directed toward all

field staff and all hired truckers required to make decisions about winter maintenance operations.

At the midpoint of the winter maintenance season, a preliminary evaluation of the training program was made by asking each highway district a series of questions about the number of training sessions held, the number of persons attending the sessions, and the reaction to the training program. Toward the end of the winter maintenance season, a post-training test (in-

miento. La segunda fase, preparación para el entrenamiento, involucra aprender los nombres, las asignaciones de trabajo y la habilidad actual, así como las áreas más fuertes y más débiles de cada participante, ésto es, conocer a cada participante como individuo. La tercera fase es el entrenamiento propiamente dicho que consiste básicamente en cubrir el tema en forma integral. Se describen estas fases en una serie de recomendaciones y sugerencias diseñadas para que una personal llegue a ser un instructor efectivo.

El noveno texto, *Appraising Results Derived from a Maintenance Training Program* (Evaluando los resultados derivados de un programa de entrenamiento en conservación), apareció también en *Highway Research Record 241* (Highway Research Board, 1968). Describe una evaluación hecha por el Departamento de Carreteras de Ontario, del uso de un programa de entrenamiento sobre control de nieve y hielo, similar al programa de Virginia descrito en el texto seleccionado N° 6. La principal parte del programa consistió de un medio auxiliar de entrenamiento ilustrado en la forma de gráficos sueltos. El programa fué preparado por un comité de expertos y utilizado para el entrenamiento de varios grupos de supervisores de

acuerdo con los principios delineados en el texto seleccionado N° 3. Estuvo dirigido a todo el personal de campo, y los camioneros contratados tuvieron que tomar decisiones relacionadas con las operaciones de conservación en invierno.

En la mitad de la temporada de conservación de invierno, se hizo una evaluación preliminar del programa de entrenamiento, preguntando a cada distrito de carreteras sobre el número de sesiones de entrenamiento efectuadas, el número de personas que asistieron a las sesiones y la reacción al programa de entrenamiento. Hacia el final de la temporada de conservación de invierno, se tomó una prueba después del entrenamiento (incluido como un anexo en el texto) a un grupo representativo del personal de campo para averiguar su nivel actual de conocimientos y evaluar el programa de entrenamiento, especialmente del medio auxiliar de entrenamiento. La conclusión del texto incluye una evaluación del éxito del programa de entrenamiento medida por las pruebas después del entrenamiento, y por los comentarios sobre mejoramiento del programa de entrenamiento y del procedimiento de las pruebas después del entrenamiento.

Se ha incluido este texto en el compendio,

travaux et des équipes, tandis que le *Trainer's Guide* indique à l'instructeur la façon de les former. Il peut être utile aux instructeurs professionnels dans la préparation de programmes de formation ou dans la présentation de sessions de formation à un centre spécial, ainsi qu'aux contremaîtres qui enseignent à leur propre équipe.

Les activités de formation sont divisées en trois phases. La première est de planification assez poussée et donne à l'instructeur la possibilité de revoir la matière et de réviser le programme lorsque c'est nécessaire. Au cours de cette phase, l'instructeur doit également s'arranger pour obtenir le matériel de formation. La seconde phase, de préparation à la formation,

consiste à apprendre le nom, la tâche, les capacités et les points forts et faibles de chaque stagiaire, en d'autre mots à connaître chaque stagiaire individuellement. Au cours de la troisième phase, celle de formation proprement dite, le sujet est étudié en détail. Ces trois phases sont présentées sous la forme de conseils et suggestions qui aident la personne à devenir un instructeur valable.

Le neuvième ouvrage, *Appraising Results Derived from a Maintenance Training Program* (Evaluation des résultats obtenus d'un programme de formation sur l'entretien des routes) est également paru dans *Highway Research Record 241* (Highway Research Board, 1968). Il présente une évaluation, menée par le Dépar-

cluded as an Appendix to the text) was given to a representative sample of field personnel to ascertain the current level of knowledge and to evaluate the training program, particularly the training aid. The conclusions of the text include an evaluation of the success of the training program, as measured by the post-training test, and comments on improvement of the training program and of the post-training testing procedures.

This text is included in this compendium as an example of the type of training program appraisals being made to ensure management that the objectives of specific training programs are being accomplished.

como un ejemplo del tipo de evaluaciones del programa de entrenamiento que se hacen para asegurar a la administración que se están cumpliendo con los objetivos de los programas de entrenamiento específicos.

Bibliografía

Al final de los textos seleccionados el lector encontrará una breve bibliografía que contiene información de referencia y resúmenes de 15 publicaciones. Las nueve primeras describen

tement des Routes de l'Ontario, de l'emploi d'un programme de formation pour la protection contre la neige et le verglas, semblable à celui de Virginie décrit dans le 6^{ème} Texte Choisi. Le programme consiste en sa majeure partie d'un tableau dépliant illustré. Il a été préparé par une commission d'experts et utilisé par plusieurs niveaux de contremaîtres selon les principes énoncés dans le 3^{ème} Texte Choisi. Il s'adressait à tout le personnel sur chantier et aux camionneurs qui devaient prendre des décisions se rapportant aux opérations d'entretien au cours de l'hiver.

Au milieu de la saison d'entretien d'hiver, afin d'obtenir une évaluation préliminaire du programme, chaque département routier a dû répondre à une série de questions sur le nombre de sessions déjà tenues, sur le nombre de personnes y assistant, et sur la réaction au programme de formation. Vers la fin de la saison, un échantillon représentatif du personnel sur chantier fut soumis à un test (publié en annexe de cet ouvrage) afin de s'assurer du niveau actuel de leurs connaissances et d'évaluer le programme de formation, en particulier le matériel didactique. Les conclusions comprennent une évaluation des résultats du programme,

Bibliography

The selected texts are followed by a brief bibliography containing reference data and abstracts for 15 publications. The first nine describe the selected texts. The other six describe publications related to the selected texts. Although there are many articles, reports, and books that could be listed, it is not the purpose of this bibliography to include all possible references related to the subject of this compendium. The bibliography contains only those publications from which a text has been selected or basic publications that would have been selected had there been no page limit for this compendium

los textos seleccionados. Las otras seis describen las publicaciones relacionadas con los textos seleccionados. Aunque existen muchos artículos, informes y libros que podrían nombrarse, no es el propósito de esta bibliografía incluir todas las referencias posibles relacionadas con el tema de este compendio. La bibliografía sólo contiene aquellas publicaciones de las cuales se seleccionó texto o publicaciones básicas que se habrían seleccionado si no hubiera un límite al número de páginas en este compendio.

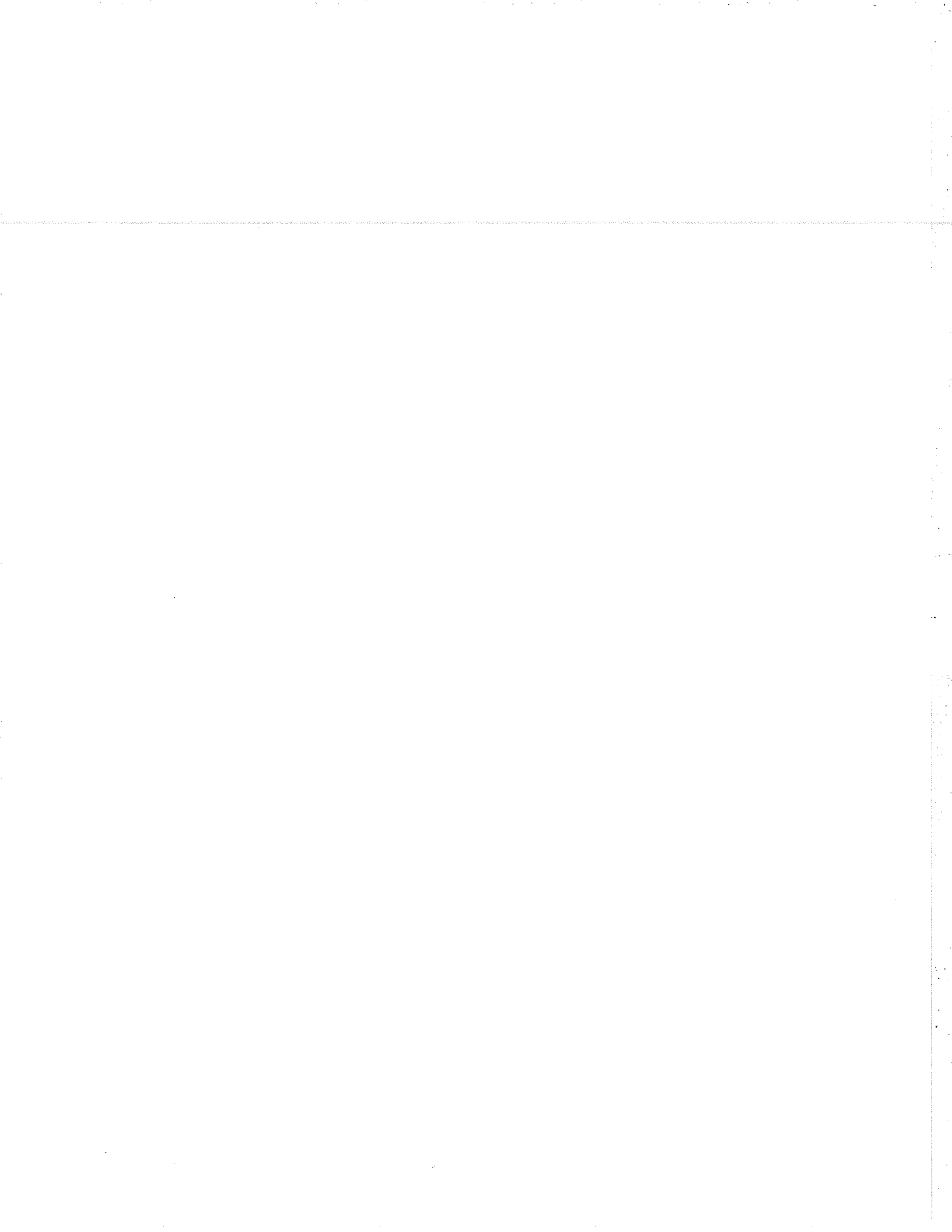
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d'après le test final, ainsi que des commentaires sur l'amélioration du programme et sur les méthodes d'examen final.

Ce texte a été inclus dans ce recueil comme exemple du genre d'évaluations des programmes de formation, qui permettent à la direction de vérifier si les objectifs de chaque programme ont bien été atteints.

Bibliographie

Les textes choisis sont suivis d'une brève bibliographie contenant les données de référence et les analyses de 15 publications. Les 9 premières s'en réfèrent aux textes choisis. Les 6 autres décrivent des publications apparentées au thème des textes choisis. Bien qu'il y ait beaucoup d'articles, rapports et livres qui pourraient être inclus, l'objectif de cette bibliographie n'est pas d'énumérer toutes les références possibles ayant rapport au sujet de ce recueil. Cette bibliographie se rapporte seulement aux publications dont nous avons choisi des extraits, ou à des textes de base que nous aurions choisis aussi s'il n'y avait pas de limite quant au nombre de pages de ce recueil.



Selected Texts

This section of the compendium contains selected pages from each text that is listed in the table of contents. Rectangular frames are used to enclose pages that have been reproduced from the original publication. Some of the original pages have been reduced in size to fit inside the frames. No other changes have been made in the original material except for the insertion of occasional explanatory notes. Thus, any errors that existed in the selected text have been reproduced in the compendium itself.

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Por lo tanto, los textos seleccionados únicamente incluyen aquellas partes de los documentos originales que están precedidas por asteris-

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UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA



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Pan African Conference on
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Ghana, November 1977

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the Governments of the United Kingdom,
France, and the Federal Republic of Germany

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PROFESSIONAL TRAINING
OF ROAD MAINTENANCE PERSONNEL
by
H.J. NEUBAUER

This conference paper has been produced through the co-operation of the Overseas Unit of the Transport and Road Research Laboratory, Department of the Environment Department of Transport, the Overseas Development Administration of the Foreign and Commonwealth Office, of the United Kingdom, and the Governments of France and the Federal Republic of Germany.

PAN-AFRICAN CONFERENCE ON HIGHWAY MAINTENANCE AND REHABILITATION

Accra, Ghana, Nov. 1977

Professional Training
of Road Maintenance Personnel

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Professional Training
of Road Maintenance Personnel

1. Introduction

The term "Road Maintenance Service" normally conveys the notion of an organization or department charged with mere maintenance and repair work in order to preserve the value of previous road investments. In reality - as every road engineer knows - there is also a variety of operational services to be rendered to ensure the permanent viability and circulation as well as traffic safety. Auxiliary services in case of catastrophies (e.g. floods, unusually heavy rainstorms, landslides, serious accidents etc.) are to be added as well as provision of information services for motorists (e.g. on traffic situations and road conditions due to bad weather, accidents, congestion etc.) and measures for traffic control and guidance. Road Maintenance Services are also regularly charged with traffic counting campaigns to furnish the necessary statistical data for medium and longterm road network planning and construction programmes. And according to our definition of Road Maintenance there are finally to be included all those activities related to the technical administration of roads such as keeping of road inventories, granting of building-permits in the vicinity of roads, permits for special use of the right of way etc.

In the context of "Training" it is not intended to dwell on questions of organization and maintenance methods. However, the brief enumeration should make it clear that Maintenance Services have to deal with a great variety of tasks within the field of competence of Road Administrations which professional training in road maintenance has to cope with. Even if some of the problems are not yet keenly felt in developing countries there is good reason to assume that development will inevitably confront the responsible authorities with a similar range of questions.

For the countries of the Third World an additional problem emerges in the task to develop appropriate maintenance methods

and policies to meet their particular requirements, providing at the same time valid answers to the questions on economy and unemployment.

The special nature of these tasks has immediate effects on personnel policy. Since the type of personnel needed for all these assignments and different levels is not readily available, the Road Administrations must to a large extent depend on themselves to train the personnel they require. This is not a peculiarity of the countries of the Third World where the educational system is not yet developed to the same degree as in industrialized countries, for this is true for us also. Training of road maintenance personnel is practically everywhere an internal affair of the responsible department. Naturally, a certain vocational training in building trades or civil engineering is required but there is no reason why Road Maintenance Services should necessarily compete in this field with well established general or technical educational schools or institutes. What is needed is an additional specialized training which cannot be acquired in these schools. This is indispensable and cannot be emphasized too strongly.

2. Target Groups of Training

Well trained personnel is needed at all levels, which can generally be distinguished as follows:

- top management
- middle management and supervisory staff
- executive staff.

Table 1 presents a listing of the personnel structure generally applicable to Road Maintenance Services in african countries. The groups which are the subject of this contribution and which are by far the largest in number are shown cross-hatched in the table.

The demand for personnel is increasing, naturally, from top to bottom. Disregarding the more or less pronounced specialisation at all levels the following applies to the individual groups:

Management staff members must as a rule hold a university degree. If there is no possibility to graduate from a

national university there is no other alternative but to study abroad. In view of the limited number of persons needed this does not pose an insurmountable problem, especially since scholarship programmes for academic studies are being offered by most industrialized countries. For later advanced and specialized training many possibilities are offered by international bodies and organizations as well as by renowned national institutes, laboratories and universities. Technical literature, feasibility studies and research reports are also very useful as a source of information to this group.

- Middle management and supervisory staff need a type of general technical training which can be acquired more and more at vocational or secondary technical schools in the native country, so that recruitment for service in the Road Administration in many countries is no longer the crucial problem. The problem remaining to be solved is the specialized training needed for the efficient performance of the technical and administrative tasks with which the individual is to be entrusted in the Road Maintenance Service. Since the demand in these cases, too, is rather limited (which in absolute figures is especially true for the smaller countries) and since organization, implementation and operation of training projects including the necessary building facilities and equipment have financial implications which cause responsible authorities to react rather hesitantly to such plans, there is all the more reason to consider possibilities of co-operation among neighbouring countries to keep costs as low as possible.

Skilled labour constitutes the largest group needing a special training in many functions. The main group is formed by the

- roadmen.

From their ranks stem the

- road foremen and
- road supervisors.

In Table 2 a survey of the most important groups of skilled labour needing training is given.

An important task besides providing specialized training consists in the selection of skilled personnel to be trained for higher qualified posts. In Germany it has been the general

rule for a long time that personnel for the posts of road supervisors be recruited among qualified foremen who in turn had risen from the ranks of roadmen. For the pressing needs in developing countries a similar policy may well provide a valid solution to the shortage of supervisory personnel and at the same time be an incentive for better work performance, although most of our own federal states - which are in charge of road maintenance in general - have recently changed their policy in favour of fully trained engineers for the posts of Senior and Chief Road Supervisors instead of career men.

In developing countries Chief Road Supervisors should in all cases be recruited among junior engineers. This is necessary and justified because in developing countries the middle management usually does not have the strong support of departmental traditions. In addition middle management must be able to act more on its own in making decisions and in executing work which goes beyond mere maintenance and repair, because rehabilitation and improvement form an important part of their work.

The second important group are the mechanics. Here the situation is very much the same as with the roadmen. The only difference is to be seen in the fact that training facilities for mechanics are more easily available in the private sector. Road Administrations therefore usually can limit their training activities to adapt the personnel to special requirements of Road Maintenance Services, e.g. the maintenance and repair of construction equipment, heavy duty machines, heavy trucks etc.

The large group of equipment operators and drivers will as a rule need additional training only, which can normally be provided and acquired by shortterm courses.

On the other hand skilled labour such as joiners, carpenters, painters, bricklayers, concrete workers etc. may be recruited from private sectors and needs no additional training.

This leaves Road Administrations with the task of training mainly three large groups, i.e.

- roadmen
- mechanics
- operators

and to select from these groups the persons qualified for future career.

3. Factors of Influence (Table 3)

The number and qualifications of the personnel required depend on the needs of the Road Maintenance Service, but for the Services themselves generally valid or applicable maintenance policies do not exist. Unfortunately there is a remarkable deficiency in scientific research regarding the questions of organization and the use of labour, and in saying this I do not exclude my own country. All administrations follow more or less a rather pragmatic way without having the certainty that they act in the most efficient manner.

A major factor affecting any maintenance policy and consequently training in maintenance, too, is to be seen in the existing organization (e.g. centralized or decentralized; operating with own equipment or hiring from independent equipment pools; force account methods or entrusting private firms with maintenance; density, condition and equipment of road maintenance depots in the country etc.).

It is always difficult to intervene in traditional or otherwise inherited structures. However, administrations should be critical enough not to shrink from examining this question thoroughly and to tackle the task of reorganization if this proves indispensable. The experience of the International Bank for Reconstruction (World Bank), which is becoming more and more involved in Road Maintenance Projects, shows that it is seldom possible to render Maintenance Services more efficient without at the same time taking reorganizational measures. The problem is not to go about it lightly, needlessly harming existing efficiency, but to proceed in a way to assure a clear definition of competencies and responsibilities according to sectors of work and levels of responsibility, thus avoiding organizational clumsiness and inefficiency. Without any such effort training projects should not be started.

For the same reasons, too, training has to follow a clear hierarchical order. Posts and job descriptions must be clearly

defined in order to avoid divergencies from the organizational set-up of the relevant Services. To better attain the aim which is to be reached and to assure that the instructors have the same ideas in mind it is necessary that the administrations which will employ the newly trained personnel, formulate standard descriptions of all professions and trades needed in Road Maintenance Services, specifying also their particular assignments (works, workshops, mobile units, service-stations, warehouses etc.).

4. Training Planning

In a simplified way the questions to be answered in the course of planning training projects can be formulated as follows:

- who is to be trained?
- for what is he to be trained?
- how is he to be trained?
- when is he to be trained?
- where is he to be trained?

Table 4 presents in other terms a survey over the main elements to be considered.

- Requirement Analysis

In an analysis of present personnel (number, age, qualifications) and comparison of these figures with present and future (medium and longterm) needs, taking into account maintenance policies and methods to be adopted as well as network planning, construction programmes and traffic evolution, the personnel needed and/or to be trained is to be identified according to

- nature
- number
- qualification and
- year.

In this comparison account has also to be taken of natural developments (e.g. changes brought about by the structure of age groups). Necessary qualifications will in turn determine whether

- shortterm
- mediumterm or
- longterm training

is to be envisaged and whether the aims of training can be accomplished by

- schooling
- on-the-job-training or
- any optional combination of the two types.

The technique of establishing a requirement analysis of this kind is well known, as they are constantly being applied by responsible departments in their personnel planning procedures, so that no further explanations need be given here.

In selecting the trainees various criteria may be applied, depending on the type of training they are to receive:

- Specific school certificates (required especially if longterm training of young persons upon leaving school is intended)
- Intelligence and vocational aptitude tests, of which a great number has been designed
- Long standing practical qualifications of present road maintenance personnel.

It is rather strange to note how often new tests are being designed and elaborated although useful tests already exist. Besides the useless duplication of efforts the new ones do not always turn out to be superior to the procedures already known.

During a transition period preference should be given to training of available personnel over newly recruited staff, which will generally need a different and longer training.

- Training Programme

According to our experience careful and exhaustive preparation of training projects is indispensable, though sometimes neglected. Going about this rather superficially will entail unnecessarily long periods of improvisation and experimentation upon project implementation. This is mainly due to non-existing or incomplete course and lecture plans, established too late. Here again it is rather startling to learn that at so many locations training projects in road maintenance are being pursued with little co-ordination and that hardly any use is being made of experience gained elsewhere, including that with training aids and material. In any

new project compilation, elaboration and repartition of subjects of instructions start all over again from scratch and it is not rare that ambition is carrying authors away to greatly expand programmes, especially regarding subjects of general culture. For this very reason I would like to appeal to all persons engaged in the field of professional training in road maintenance to act more generously in making written material available to their colleagues, since very often material of this kind is not being published and therefore not available through sale.

A concise survey of subjects of instruction for the training of roadmen and road foremen is given in Table 5. This includes not only road maintenance but also road rehabilitation and basic knowledge in road construction.

In establishing medium and longterm training programmes consideration should be given to the necessity of publishing and disseminating early information on dates, types, number and duration of courses. This is not only necessary for the on-the-spot-preparation (facilities, equipment, seasonal maintenance operations, teaching staff etc.) but also to allow potential trainees to prepare themselves for selection tests and training courses.

- Instructors

Selection and recruitment of instructors will often determine success or failure of a training project. It is of utmost importance that trainers or instructors have ample practical experience on the subject combined with a natural gift or ability for teaching and managing people, in other words to bring about a transfer of technical know-how. This process is always linked with the ability to use the appropriate colloquial speech especially when dealing with people not having attained higher educational levels. Particularly when the Federal Republic of Germany finances and assists training projects this latter difficulty is considerably increased by the language barrier, for whenever we have the man who would suit the task in his capacity as technical expert and instructor he will most likely not have sufficient command of the foreign language and vice versa. This is especially true for personnel

which we try to find among civil servants of the German road administrations, where the knowledge of foreign languages is not required but where there exists the greatest potential of experts. Neither consultants nor construction firms have similar expertise at their disposal since road maintenance in Germany is an exclusive task of the public administration. Another potential group, i.e. the instructors or lecturers from technical schools and universities, has practical experience in road maintenance as well as a good command of foreign languages in very rare exceptions only, though they have the necessary pedagogic qualifications.

We have a system of long standing in Germany of assigning experienced civil servants to instructors for the internal training of young personnel joining the road department. For them training is a part-time activity besides their official duties. I am mentioning this because in my opinion developing countries in turn should strive to provide themselves as fast as possible with a competent staff for training purposes by having own personnel trained in due time as counterparts. This applies to technical instructors. Teachers for lessons in general subjects (e.g. mathematics, physics, chemistry, languages etc.) who are needed for longterm courses, do not form the crucial bottleneck. They are usually available in the country and should therefore be taken ~~under~~ contract from existing local schools on a part-time basis in agreement with the competent authorities.

- Building Facilities

The answer to the question of the kind of arrangements to be made regarding buildings and accomodation depends on the type of courses to be given. However, it should be generally accepted that even for "on-the-job" training a classroom has to be provided for lectures which are necessary for a better understanding of the practical training and to widen the perspective for practical application by understanding the underlying theory.

As a rule good results have been obtained at training centres which are attached to maintenance depots, the so-called training maintenance depots, with all necessary equipment and workshops, dormitories and permanent staff at it's disposal. At this

facility training activities are concentrated to cover the needs of the entire country, the trainees being delegated there for the duration of the individual courses.

However, the setting-up of such a centre is justified only if permanent training activities are assured for at least several years. For this reason the idea of co-operation in this field should appeal to the smaller countries in need of a relatively modest number of trained personnel which hardly justifies an independent and expensive training programme. This co-operation can take place either among neighbouring countries and/or different administrations. If intermittantly used by road administrations only the training centre may be used in the meantime for other purposes, too (e.g. for agricultural training, courses for personnel supervising and maintaining irrigation and water supply systems etc.).

- Equipment

Teaching and learning aids for theoretical training are available in great variety. However, the majority of these is intended for use in advanced training, at technical schools and universities or by experienced personnel. The aids for training skilled labour and lower level supervisory staff in road maintenance are by no means abundant. Great care must be taken therefore in choosing the appropriate teaching materials in order not to overtax trainees. The proposal put forward by my colleague for the compilation and publication of a concise and easily understandable, well illustrated road maintenance manual deserves in my opinion widespread attention and further action.

Practical training in operating and maintaining road maintenance equipment has to comply with actual needs of the Services and these in turn will determine type, kind, number and size of equipment which should be available for training.

A fully equipped soils and materials laboratory is not deemed absolutely necessary. Nevertheless in order to promote comprehension of quality requirements the basic equipment for routine quality controls on construction sites should be at the disposal (e.g. for the control of soils and aggregates with

respect to cleanliness, grading and practicability for embankments, foundation-, base- and wearing-courses; density and compaction tests etc.; not necessary is equipment for testing bituminous binders etc., which task should be left to the National Laboratories which exist in almost all countries).

- Administration

Competent project administration and management is essential for smooth and efficient project operation. It goes without saying that appropriate permanent office staff must be available for this task which will comprise all affairs relating to personnel, accounting, daily operations of the centre etc.

However, I have in mind here the term administration in the meaning of central administration at ministerial level where the overall responsibility for training activities rests. In the Ministry responsible for roads there should be a Commissioner for Training whose task it would be to plan, direct, supervise and control all training activities.

Efficiency control must be a permanent practice in finding out not only how many trainees pass final examinations, but also:

- what use they make afterwards of their newly acquired knowledge
- if the intended better maintenance has been achieved
- if instructors meet all expectations
- which modifications to the programme seem to promise even better results
- if there are any gaps or shortcomings in training that need attention?

These findings have to be discussed with the training project manager and the instructors in order to be incorporated accordingly in programmes, courses, lectures and overall future strategies. In addition a general review from time to time of training activities is strongly advocated to provide for necessary amendments by comparing present needs in the light of development with original aims and requirements.

All factors treated so far and affecting the planning of training projects are compiled in Table 6 in the form of a flow-chart.

However, planning is not complete if it does not include measures to assure

- immediate and competent employment of the trainees (appointment)
- appropriate payment and
- regulations for possible future careers.

Social career is an important stimulant for motivation and only by providing this kind of incentive will higher efficiency be achieved to the mutual advantage of the Road Administration and personnel.

5. Training Models

Many models are conceivable for training. Two cases are commonly known:

- school training and
- on-the-job training.

Between these intermediate models or combinations are perceivable as has already been mentioned above.

Besides there is the question of the length of training:

- Shortterm training (4 - 8 weeks) usually is directed at checking and supplementing practical skills and complementing these with theoretical lessons in order to expand possibilities for practical application by better understanding and to create a sound base for decisions involving higher responsibility.
- Longterm training may advantageously be organized as a combination of
 - short periods of theoretical training at the training centre interspersed with
 - longer periods of practical training in the home-unit during which newly acquired knowledge may be applied and broadened.

In this way personal problems may best be taken into account also, namely separation from family, home and familiar work, uprootal etc., especially in the case of older trainees.

Factors and arguments to be considered when selecting an appropriate training model are given in Table 7.

The training of skilled personnel for higher qualified supervisory posts will usually be of the longterm type (1 - 2 years). A synopsis of the advantages and disadvantages of the

combined form of longterm training indicated above (combination of theoretical training at training centre and practical training in home-unit) produces substantial arguments in favour of this model compared to fulltime training at the centre (see Table 8).

It can easily be deduced from the arguments given there that I consider this model, which presently is being practised in Liberia, as a very promising one. A detailed account of this will be given by the project manager (see also chapter 10).

6. Problems

There is the slogan of technology transfer, the transfer of know-how, a process into which great hopes have been placed by both the industrialized and the developing countries for a faster development of the Third World. In this context one normally thinks rather of the industrial or productive sector. Supplying know-how in the field of training in road maintenance no doubt also comes under the heading of technology transfer.

The difficulties which make themselves felt in all fields of technology transfer are the same for road maintenance projects. There is first of all the danger of one-sided transfer of technologies which were originally conceived and developed under different conditions, without taking sufficiently into consideration as to whether technologies and methods are properly adapted to the situation in the developing country. In this respect much more has to be done for an exchange of experience and for a closer co-operation between African and industrialized countries with the aim of providing instructors with a better understanding of social, economic, cultural and technical conditions and traditions in order that the transferred knowledge finds the fertile soil to thrive.

There is a great number of techniques for individual maintenance operations readily available. Generally it is not too difficult to modify them so that they may better suit specific requirements. The problem is rather to recognize where something should be adapted. This is to a great extent a problem of communication and where this communication does not exist technology transfer will remain a one-sided affair of passive acceptance. In this case the basis for future

difficulties, misunderstandings, unsatisfactory results, setbacks or even the complete failure of the project is laid.

Apart from some small and common problems which consistently crop up wherever people live together, the following are typical difficulties of training projects which can and should be avoided:

- Insufficient planning and preparation of training projects.

This means that the training activities are started before a sound and effective programme has been established in detail. Consequencies are

- slow and uncoordinated progress, sometimes taking years until full efficiency has been gained
- continual changes of the terms of reference with a plain tendency for expansion of the project
- low output
- dwindling interest and engagement on both sides because of unfulfilled expectations.

One should never commit the error of estimating requirements and costs too low in order to get the project more easily accepted, since this may inevitably lead to the rejection of future training projects.

- Provision of counterparts.

One should expect that the training of roadmen, foremen, supervisors, operators, mechanics, workshop superintendents etc., in other words of the executive and supervisory staff of Road Maintenance Services could at a very early stage be taken over by civil servants from the national road maintenance service, if a sufficient number of them had been trained for this purpose while acting as counterparts to expatriate instructors during the first one or two courses. In this way expatriate personnel could be withdrawn at the earliest possible moment in order that the project may continue on its own with local guidance. Unfortunately it is not a rare experience that counterparts are reluctant to being attached to the project, that they are attached too late and too small in number and with too frequent later changes, since many of them (usually the best qualified) soon find more attractive posts in the department. This tendency could be countered only by well conceived and strictly adhered to

personnel policy with the aim of keeping certain attractive posts in the administration reserved for instructors who have given proof of their professional competence in training. Knowing of the shortage of personnel qualified for these activities I can, however, see the difficulties which stand against such a scheme and I also understand the ambition of many potential instructors to do more "productive" work. Yet I strongly advocate that measures be taken to limit the fluctuation of counterparts by providing incentives regarding the future career of the trainers.

- Integration of newly trained personnel into the administration.

If successful course participation (esp. in longterm training) does not provide sufficient guarantee that newly trained personnel be immediately entrusted with relevant tasks, which includes post assignment, higher responsibility and accordingly better salary as well as favourable prospects for future career and social standing, this will soon prove harmful to the professional motivation of trainees.

- Improvised training activities due to lacking plan of instructions.

Sometimes a detailed and well balanced plan of instruction is completed only long after the project has started. This important work could be facilitated if data and records from similar projects were put more freely at the disposal of those engaged in planning training projects. It is my impression that in the case of Consultants being entrusted with this type of work they are not partial to an unchecked exchange of training data and material established by them. This is where the financing agencies of training projects should stipulate that lecture plans, syllabus of courses, courses of instructions, training manuals etc., once established and compiled, be freely available for use in other training projects. After all, financing bodies cannot be interested in having to pay for the same consulting work over and over again with every new project, if relevant documentation needs only be taken from the files and subjected to some slight modifications or amendments to suit the new project.

- Deficiency of national vocational educational systems.

It happens that for some of the positions needed for road maintenance services uniform and recognized vocational training systems do not yet exist everywhere. This induces technical assistance giving countries and organisations to pursue within their field of activities vocational training systems of their own country. Once there are several vocational training projects financed by different agencies in operation in one and the same country this may lead - and to my knowledge has in some cases led - to a side by side existence of nominally identical occupations which in reality are not equal. An additional uncertainty is assessing the value of certificates due to the fact that conditions for admission may differ from one school or institution to the other and consequently, that holders of nominally equal certificates from different schools may have attained different levels of education. For this reason it is generally necessary that selection tests be held for the potential trainees rather than relying on certificates only. Further tests at the beginning of courses are advisable to find a sound and common basis for instructions. Taking too much for granted and starting off too fast may cause difficulties which drag through entire courses. Taking the time to consolidate the base of knowledge from which to advance will certainly pay off later.

7. Possibilities for Inter-African co-operation in training

Expenditures for training in terms of money, time and personnel are not negligible. These expenditures can be limited to a certain extent if experience, data and results from similar projects anywhere can be used - as already mentioned above - as contributions to new projects. In other words, African countries can draw worthwhile profit from co-operation. This is true for example for the following sectors:

- establishment of criteria for the admission of trainees, including selection tests
- establishment of course programmes, lecture plans, syllabus of courses
- establishment and publication of training aids, manuals etc.
- exchange of experience between different countries actively engaged in training.

Where the provision of training facilities in one country alone does not prove economic because of limited requirements, co-operation is even more imperative. Apart from permanent training centres co-operation is also recommended in the organization of seminars, of study tours etc.

There are examples of initiatives in this direction. As a recent one I should like to cite here the "Draft Report of the Intergovernmental Expert Group Meeting on Asian Highway and International Road Transport of 1.11.1975" in Bangkok, seat of the Economic and Social Commission for Asia and the Pacific (ESCAP) with its Transport and Communications Committee:

"On the question of systemizing and co-ordinating training activities it was proposed that a Central Training Institute for road engineering and management might be considered. Some experts advocated decentralization in different countries for different types of training. However, the need for a central co-ordination of training needs and opportunities was recognized to include:

- 1) identifying the nature and type of training
- 2) collecting and evaluating information and data on training activities in different countries
- 3) establishment of co-ordinated training programmes for the whole region with determination of locations for each type of training
- 4) co-ordinating national training programmes of interest to other countries of the region and arranging participation of their trainees
- 5) providing assistance to governments upon request to organize training courses, seminars and workshops and arranging for lecturers, fellowships and necessary equipment
- 6) selection of participants
- 7) providing ad-hoc overall advisory services in the field of training."

I am citing this example because I find it perfectly in line with evident needs of the majority of African countries. If this opinion is shared by the participants here, I would like to suggest that this meeting pass a resolution requesting the UN-Economic Commission for Africa (ECA) that its Trans-African Highways Bureau (TAHB) conduct an inquiry in order to find out

which countries already follow a systematic training policy, the kind and scope of training activities pursued. Furthermore that the TAHB should compile the answers and make them available to all other interested countries. This inquiry per se would already facilitate co-operation between administrations wishing to do so. It would be even more encouraging if ECA would accept co-ordinating activities similar to those ESCAP is doing for the Asian countries.

I feel myself urged to propose this suggestion since I know from experience - and this may justify my move - how difficult it is to have a complete perspective of ongoing activities in this field at present.

8. Final Remarks

Road Maintenance is only one among many responsibilities of a government which has to decide on priorities of expenditures and in doing so has to wrestle with many contradictory interests. It is a worldwide practice, I think, that the budgets of road authorities are among those chosen where substantial cuts have to be made. This may be justified or understandable in the case of new construction work, which may be deferred for a while, in the case of cuts or otherwise insufficient budgeting for road maintenance this will inevitably entail a partial or complete loss of already existing road investment by deterioration and a subsequent increase of maintenance or construction costs compared with that for normally and adequately maintained roads. Road deterioration will furthermore directly increase transport costs, costs of living (especially keenly felt in remote regions) and complicate supply situations.

High decision making governmental bodies being approached with a demand for any such "unproductive" projects as training (and this by an administration which is not normally responsible for training and education) may be tempted to reject too lightly such requests. This should not discourage responsible road authorities, on the contrary, they should repeat their efforts to convince those concerned that costs resulting from the deterioration of roads and structures are higher than those for adequate maintenance (this is discussed in the British contribution)

and that maintenance can be most effective only if the services have the best qualified personnel possible at their disposal, which can be obtained and secured by training programmes only.

A means for helping to convince financing bodies or Technical Assistance Agencies, of the feasibility and viability of training projects is the cost/benefit-analysis (CBA). A simple schedule outlining some facts involved is given in Table 9.

It is obvious that training which leads to better careers is a powerful factor of motivation and contributes considerably to increased efficiency and quality of Maintenance Services within the scope of the individual's personal responsibility. How strongly road maintenance depends on human motivation may finally be underlined by the following condensed quotation from the American Highway Engineering Handbook:

"Highway maintenance is not an exact science. The same type of road in different locations requires different maintenance operations. Consequently, repair methods which give good results at one location may not be the proper methods at another location. Thus it can quickly be seen that experienced men with good judgement are the key to proper maintenance. A maintenance man must have a wide knowledge of the use of many materials, he must have personal skill in the operation of many pieces of equipment, he must have a sense of precaution in order to protect himself, his men and the public during maintenance operations and, finally, he must be able to work with men and meet the public."

Table 1

Personnel Structure of Road Maintenance Services
in French and English Speaking African Countries
and Main Target Groups for Training Project

I. Entretien Routier Road Maintenance

Chef d'Arrondissement	Regional Engineer
Chef de Subdivision	District Engineer
Adjoint Technique	Chief Road Supervisor
Conducteur de Travaux	Senior Road Supervisor
Chef de Secteur Chef de Brigade Engins	Road Supervisor
Chef d'Equipe	Road Foreman
Cantonnier/Conducteur d'engin	Roadman / Operator
Aide Cantonnier	Semi-skilled Labour
Manoeuvre	Unskilled Labour

II. Entretien du Matériel Equipment Division

Chef du Service du Matériel	Head of Equipment Division
Inspecteur du Matériel	Equipment Engineer
Chef d'Atelier	Head of Workshop
Contremaître Mécanicien d'Atelier	Equipment Inspector
Chef Magasinier	Store-keeper
Chef d'Equipe	Senior Mechanic
Mécanicien d'Entretien	Mechanic
Aide	Semi-skilled Labour, Driver
Manoeuvre	Unskilled Labour

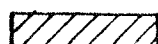
 Main Target Group for Training Project

Table 2

Survey of Important Training Courses

I. Road Maintenance

Roadmen	Theory and practice of road maintenance, including techniques, materials, planning and execution, efficiency control etc. (going more into detail with rising level of personnel)
Roadforemen	
Road Supervisors	
Senior Road Supervisors	

II. Equipment

Operators	Operation and maintenance of construction machines and equipment; fields of application; understanding important equipment; Special mechanical training may be necessary for heavy duty equipment
Mechanics	Particular courses are to be organized for: - motor mechanics - vehicle mechanics - motorvehicle electricians - specialists for Diesel-motors - hydraulic mechanics - turners, welders etc.
Store-keepers	Supplying and storing of tools and spareparts, running of filling stations, storage yards etc.
Workshop Supervisors	Advanced training of qualified mechanics in fault location and repair, keeping of labour reports, labour assignment, supervision of personnel etc.

Table 3

Main Factors Conditioning the Analysis of Needs in Road Maintenance Personnel

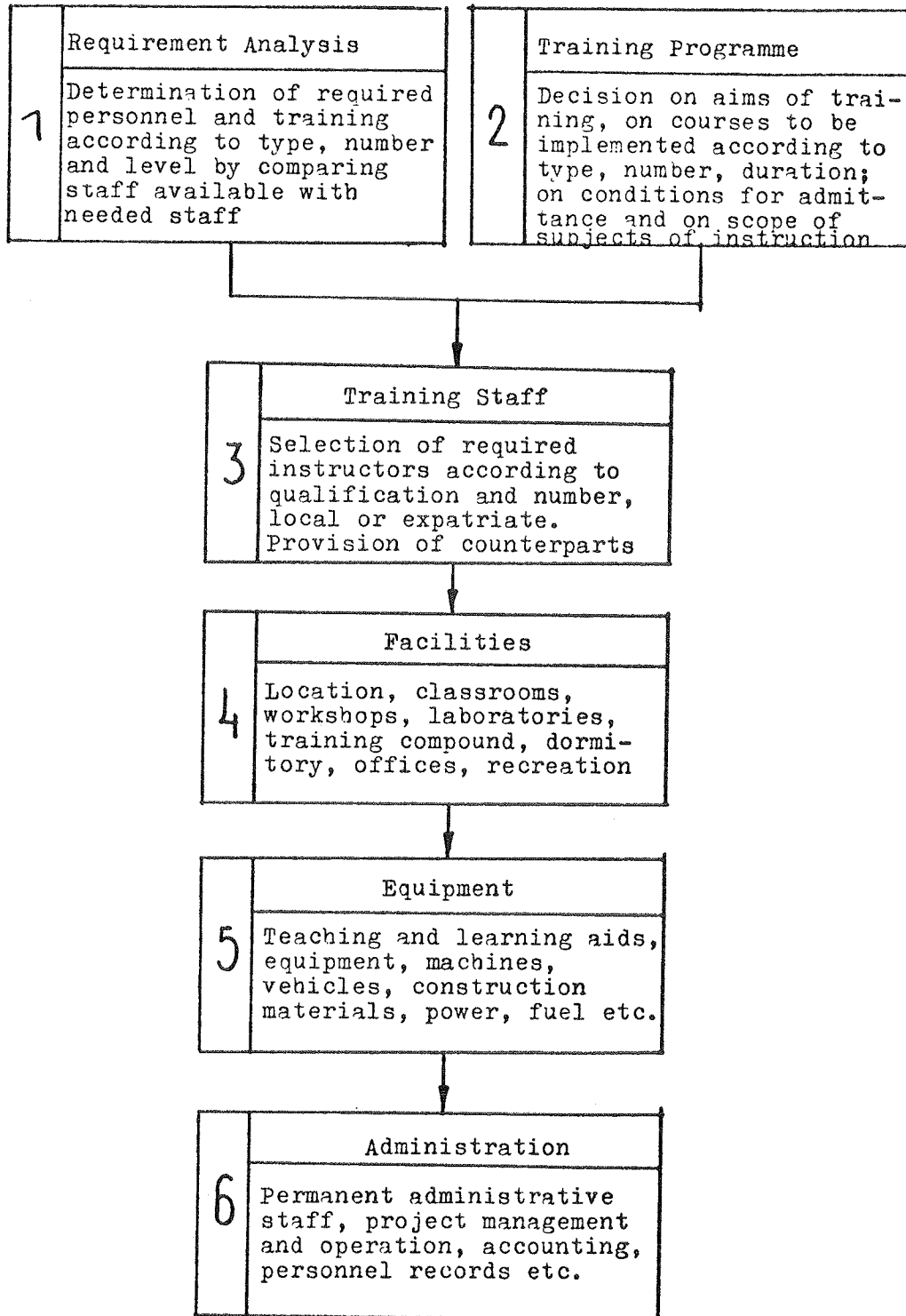
Evaluation of present situation	Future needs (forecast)
Structure and length of road network (classification / carriageway widths / road conditions etc.)	Development of road network
Average daily traffic (volume and loads)	Future increase in traffic
Percentage of various types of pavement (earth/gravel/bituminous roads)	Future changes in pavement standards (e.g. by upgrading)
Maintenance methods and degree of mechanization	Changes in maintenance policy and methods to be achieved
Organizational set-up (central / regional authorities)	Eventual re-organization of the Road Administration (structure/responsibilities)
Maintenance budget (necessary / available funds)	Future budget requirements in view of altered or new maintenance strategies
Number and location of Road Maintenance Depots, incl. size, equipment etc.	Reorganization of Maintenance Districts, additional Maintenance Depots needed etc.
Available personnel (number/type/qualification)	Personnel needed in future (number/type/qualification)

Training Requirements
(type/number/scope/level/
methods/long or short term)

Decision on implementation
of training programmes

Table 4

Main Elements of Training Projects



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Table 5

Subjects of Instruction
for Practical Training of Roadmen

1. Road Maintenance
 - 1.1. Routine, periodic and emergency maintenance:
 - principles, conception, purpose, importance, types, methods and scope
 - 1.2. Principles of maintenance of
 - tracks
 - earth roads (grading)
 - laterite roads (patching, grading, re-surfacing)
 - gravel roads (patching, grading, re-surfacing)
 - bituminous roads (patching, surface dressing, overlays)
 - where necessary: concrete pavements, blockstone pavements
 - 1.3. Important binders:
 - kinds, properties, workability, fields of application of
 - bitumens
 - tars
 - cut-backs
 - emulsions
 - hydraulic binders, oils etc.
 - 1.4. Aggregates
 - kinds, properties and field of application of
 - soils
 - sand
 - gravel
 - crushed stone etc.
 - 1.5. Maintenance of
 - shoulders
 - ditches, gutters, drains etc.
 - traffic signs, markings etc.
 - 1.6. Maintenance of
 - bridges and culverts
 - retaining walls etc.
 - 1.7. Maintenance of roadside vegetation (bushes, trees, grass covered surfaces)

1.8. Miscellaneous

- access ways
- traffic counting
- traffic regulations
- borrow pits, sand pits, quarries
- service mains in roads (esp. water)
- telephone and electrical lines

2. Road Rehabilitation

2.1. Repair and reconstruction sites

- site set-up, organization and control
- traffic handling at the sites

2.2. Road Construction

- earthworks (natural ground, cut and fill, subgrade, formation)
- soil stabilization
- sub-base layers
- binder and wearing courses, surfacings

2.3. Construction Tools and Equipment

- excavation, loading and transporting, drilling, blasting
- spreading, placing
- compacting

2.4. Bituminous Mixtures

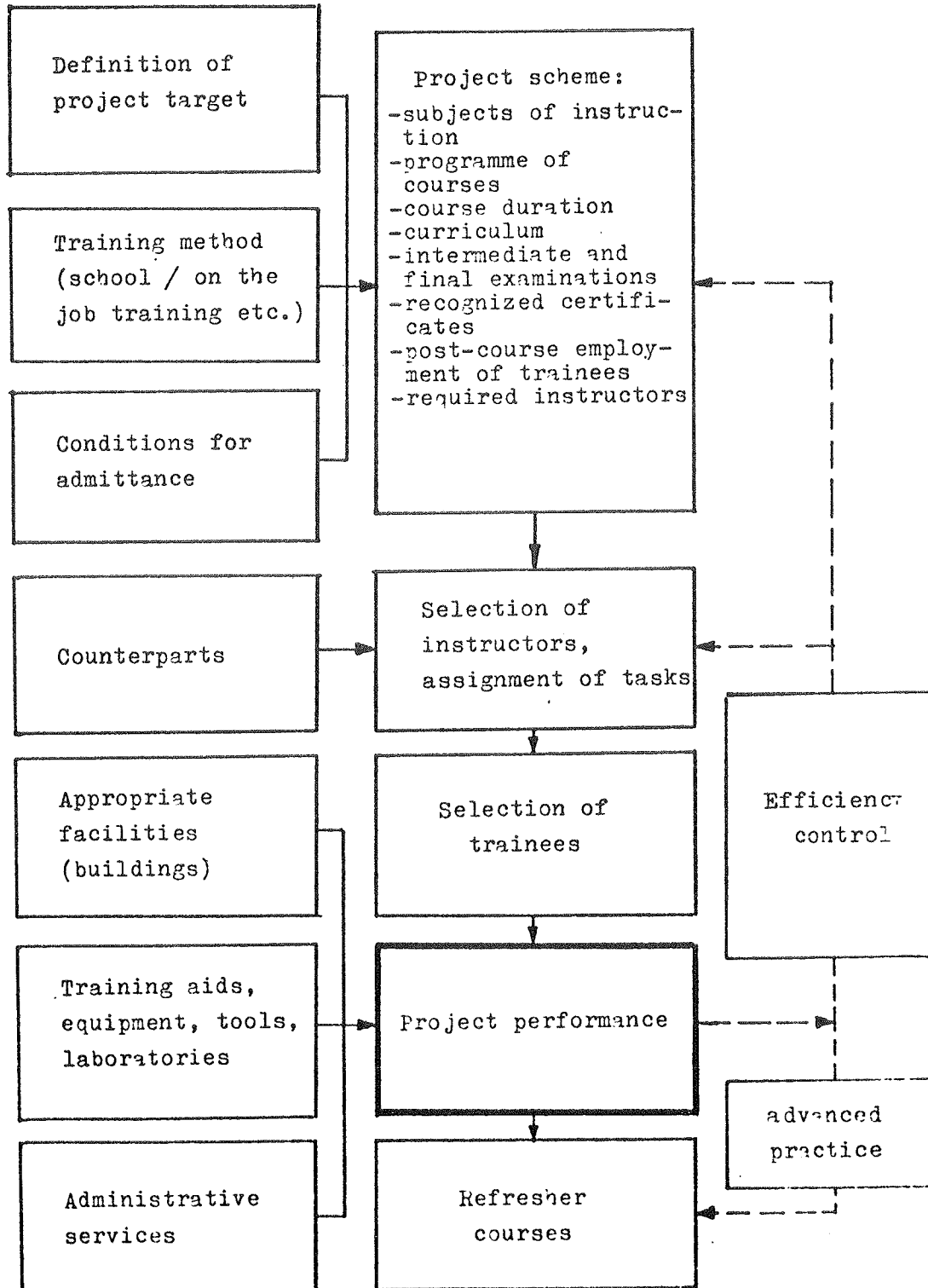
- types and mix composition
- fields of application
- instructions for use

3. Training Road Foremen and Supervisors

- Principles of planning and supervision of construction sites and work
- Establishment of simple sketches and designs (cross sections, lay-out, longitudinal sections)
- Bills of quantities and cost estimates
- Time planning and management procedures
- Pegging out work (e.g. culverts, ditches, slopes, curves, cross slopes, gradients)
- Quantity and quality control
- Keeping of daily work records
- Cost accounting

Planning of Training Projects

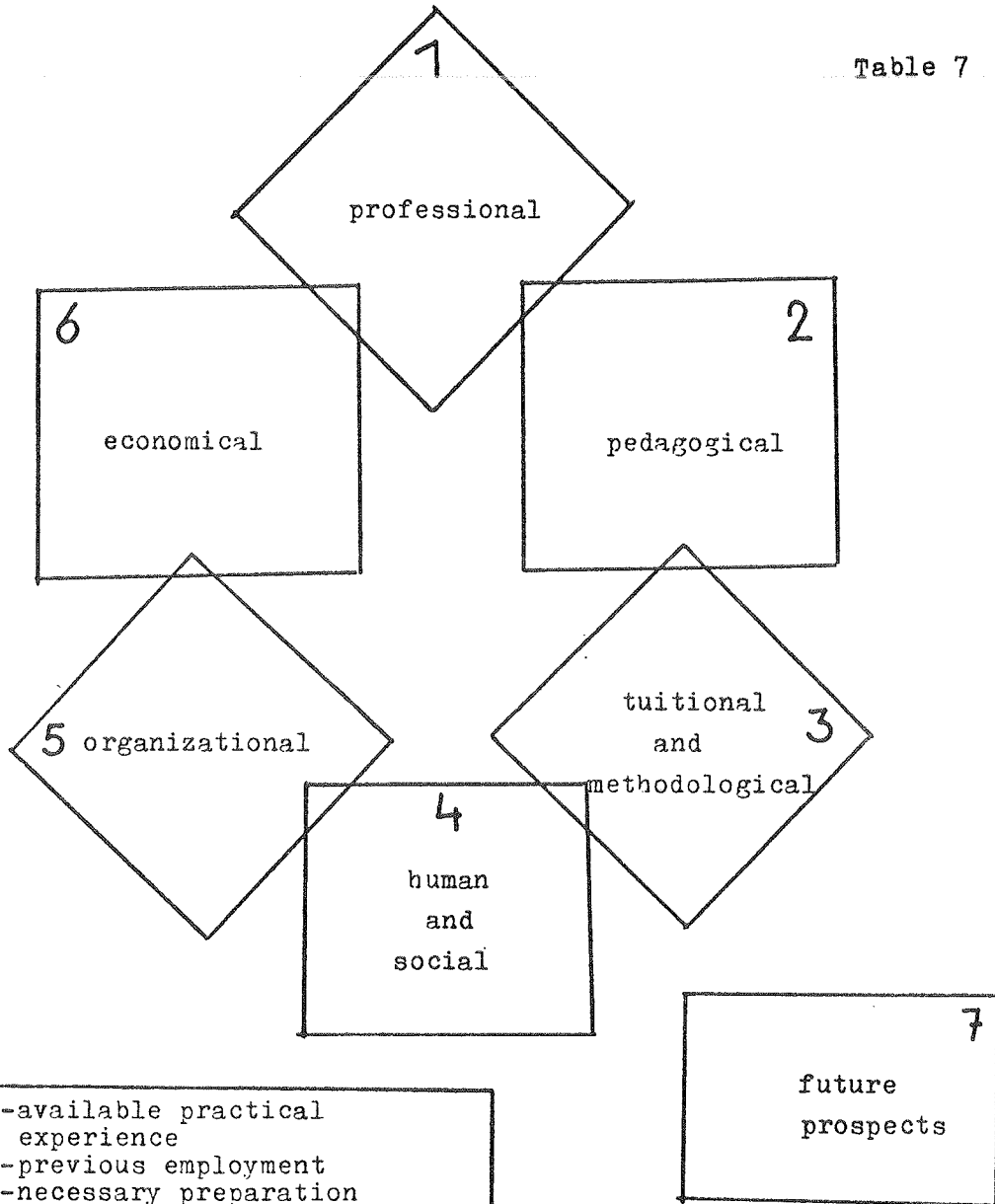
Table 6



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Factors to be considered in planning a training project

Table 7



1	-available practical experience -previous employment -necessary preparation		
2	-education aiming at efficiency and responsibility -affiliated persons -confrontation of theory and practice	5	-arrival and departure of trainees -accomodation -employment -vacation
3	-composition of the group -expansion of basic knowledge -training aids, workshops -interruptions of training	6	-selection of trainees -efficiency and payment -equipment operation
4	-absence from home and work -entertainment -breaking off of training -composition of courses -social advancement	7	-expansion of administration -adaptation to development -motivation -migration of personnel

Table 8

S y n o p s i s

of advantages and disadvantages of longterm training in the form of short theoretical training periods at the training centre interspersed with longer periods of practical training in the home-unit:

Advantages

- The first course allows determining the level of knowledge or education of trainees
- For the second course instructions and lessons can be adapted accordingly
- Between successive courses specially directed practical training is possible to adjust for one-sided skills acquired until then
- Contrary to pure training units this model provides ample opportunity for responsible action in actual maintenance work
- One instructor is in charge of one course only at any time, so that he may devote himself better to individual trainees
- The composition of the class can easily be modified for the next course
- The amount of equipment and training aids necessary is smaller, if one course only is held at the time
- For periods between courses trainees can be given more extensive home-work
- Absence from home and working unit is shorter and the danger of family alienation reduced
- Danger of breaking-off training during a course is also less while leaving after first course is possible
- Composition of classes leading to unsociableness or tension can more easily be modified (tribal membership, race, religion, age etc.)
- Rise in social standing takes place step by step with each course
- Practical work is executed in a familiar environment and with known personnel
- No weekend and holiday journeys necessary
- Lower costs for accomodation since no additional courses are to be held at the same time
- Planning of vacation periods for instructors is facilitated

- Lower economic loss of manpower, since productive work is done between theoretical courses
- Necessary close contact between training centre and maintenance depots will prove to the advantage of the entire maintenance services
- A sense of competition may be created among maintenance depots or districts to make success of training visible
- Finally, best adaptation possible to local conditions may be assured by this model

Disadvantages

- Practical work of trainees cannot be as effectively controlled and directed as at training centres
- Short courses leave little or no room to close gaps in basic knowledge. This has to be left to the initiative of the trainee between instruction courses.
- Each course needs a new running-in-period due to the interruptions between courses
- More administrative work will accrue (repeated convening of the same class)
- Advance planning over longer periods is necessary
- Full activity of instructors is required while courses are running

Table 9

Schedule of a Simplified
Cost - Benefit - Analysis for Training Projects
(according to the "with and without principle")

Criteria: $\frac{B}{C} \geq 1$

1. Costs of Training = C	
	1.1. Direct costs
	<ul style="list-style-type: none"> - costs of teaching aids - costs of instructors - operating costs of the training centre - depreciation of investment in training centre
	1.2. Indirect costs
	<ul style="list-style-type: none"> - trainees' lost working output due to participation in training course - reduced efficiency of working group due to absence of trainee - additional depreciation of equipment due to training activities
2. Benefits of Training = B	
	<ul style="list-style-type: none"> - application of better methods in highway maintenance activities - savings due to better and more economical use of equipment and materials - better organization of maintenance crews and their more effective distribution on the highway network - better understanding of the principles of highway maintenance and the costs involved - better control of budget expenditures - savings in transport costs due to better maintained road surfaces - increase in income of participants being assigned to higher ranking and better paid posts

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UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA



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ROAD MAINTENANCE TRAINING -
THE WORK OF A SPECIALIST ORGANIZATION
by
I. HAMILTON

This conference paper has been produced through the co-operation of the Overseas Unit of the Transport and Road Research Laboratory, Department of the Environment, Department of Transport, the Overseas Development Administration of the Foreign and Commonwealth Office, of the United Kingdom, and the Governments of France and the Federal Republic of Germany.

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1. INTRODUCTION

1.1 OBJECTIVES

In the framework of the 1977 Conference on Road Maintenance and Training in Africa, the first section of this paper looks at training from the point of view of an organization with vast world-wide experience in this field. The second section of the paper gives some details of ORT's projects in Road Maintenance training in Africa, followed by a third section which gives an outline of ORT's general approach to such projects from initial survey through implementation to evaluation. The fourth section deals with the lessons learned by ORT and recommends ways of making training for Road Maintenance personnel more effective.

1.2 ORT

The Organization for Rehabilitation through Training (ORT) is a private, non-profit organization with 97 years of experience in vocational training. It has programs in 32 countries, with approximately 70,000 students in 700 schools, and training units with courses covering 100 trades. From the headquarters in Geneva, ORT manages the largest non-governmental training network in the world.

Since 1960, when it entered the field of technical assistance, ORT has operated in more than 20 African countries in both French and English-speaking territories.

ORT has become very active in Transportation, and especially in the field of Road Maintenance training and management. A major and continuing project exists in Zaire, where in three years 1,100 people have been trained and 1,200 km of road rebuilt and maintained. In Chad, 150 operatives are

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being trained, 83 km of road have been reconstructed, and a 2 km airstrip built. In Nigeria, ORT is working with the Ministry of Public Works a countrywide maintenance management and training project. Another major project started in Tanzania in December 1976 and involves managing road maintenance for the southern half of that country, as well as running a training school. Road maintenance training studies have been carried out in Burundi, Kenya, Rwanda, and, most recently, in Swaziland. A study of labor-intensive road construction was carried out this year in Botswana.

In all this work, ORT has been closely associated with major donors such as the World Bank, United States Agency for International Development, Organization for Economic Cooperation and Development, European Economic Community, Swiss Technical Cooperation, Canadian International Development Authority, and the Swedish International Development Authority. ORT enjoys consultative status with specialized agencies of the United Nations and is registered as a technical assistance resource with the U.K. Ministry of Overseas Development, the World Bank, and regional development banks serving Africa, Asia and Latin America.

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1.3 SUMMARY OF OBSERVATIONS AND SUGGESTIONS

The observations and suggestions from Chapter 4 are summarized here for ease of reference.

- For various reasons, road maintenance has been neglected and skilled local staff have not been trained.
- Therefore, there is a need for extensive retraining of existing road maintenance staff and of recruitment and training of new staff.
- Management in Roads Departments must plan the use of newly-trained staff and, if necessary, adapt the organization to exploit them fully.

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- Management should be closely involved in designing job specifications around which training will be planned.
- Senior staff, both management and supervisors, should be included in any training program.
- Training is designed to equip a person for a particular job and this limitation should be accepted and explained to trainees.
- Retraining of existing staff should be given priority, but the limitations recognized and new staff recruited where necessary.
- New staff to be recruited should be carefully selected in relation to the job specifications and the training program requirements.
- Posts should be provided for the newly-trained staff, in order to avoid frustration and low morale.
- It is essential that the Roads Department select competent technical personnel as counterparts to the expatriate instructors at an early stage of the training program.
- An effective manpower survey is a necessary first stage before a training program starts.
- Mechanical maintenance is often critical, and where a central organization exists, consideration should be given to a decentralized system giving organizations like Roads Departments a separate mechanical maintenance capability.
- Where it seems appropriate, consideration should be given to labor-intensive methods of construction and maintenance to avoid reliance on equipment.

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2. COUNTRY PROGRAMS2.1 ZAIRE

Zaire spans the equator, has an area of 2,345,000 square kilometers and a population of about 26 million. Apart from the River Zaire, the second largest river in the world by volume, there are many other navigable rivers. Half the country is covered by evergreen equatorial forest, with high temperatures and heavy rainfall.

2.1.1 Contract

The three-year contract with the Roads Department in Zaire was signed in 1971. It provided for training in the following categories of Road Maintenance personnel:

Foremen	60
Equipment Operators and Drivers	320
Mechanics	180
Storekeepers	<u>40</u>
TOTAL	600

2.1.2 Structure

The organization included an ORT Project Manager and 33 specialists responsible to the Director General of the Roads Department for the direction of the project, and an ORT Training Coordinator, responsible for all progra- planning.

Training was carried out through five Training Centers and five Training Production Units. The average proportion of time spent on theoretical work was 15%, the balance being spent in practical on-the-job training in Training Production Units.

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The staff assigned to the project were:

ORT Specialists	34
Peace Corps Volunteers	13
Local Personnel	72

2.1.3 Results

The results of the project are divided into personnel trained and reconstruction and maintenance, through in practice the training was mainly achieved through the Training Production Units.

2.1.3.1 Trained Personnel

The total personnel trained were as follows:

Engineers	38	
Foremen	60	(60)
Equipment Operators		
Drivers	341	(320)
Mechanical Trades	568	(180)
Storekeepers	40	(40)
Counterpart Instructors	25	
Miscellaneous	20	
TOTAL	1,092	(600)

The original contract targets are shown in brackets for comparison.

2.1.3.2 Training Production Units (T.P.U.)

During the period from March 1972 to November 1974, three Reconstruction T.P.U.s and two Regrading T.P.U.s achieved the following results:

Reconstructed - earth roads	575 km
Grading - earth roads	966 km
Maintenance	1,958 km

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The Training Production Units (T.P.U.) were fully-equipped operational units. At the head of each T.P.U. during the contract period was an ORT civil engineer assisted by an ORT mechanics superintendent. The T.P.U.s operated with a small nucleus of experienced personnel, the main operating labor force of supervisors, operators, drivers and mechanics being trainees. During their time with a T.P.U., the trainees, who had received basic training in a Training Center, were under the supervision of experienced instructors, who would regularly review their performance. Mobile classrooms were used for revision lectures on basic procedures.

It is not easy to separate costs within such integrated units, but the following figures give some idea of potential savings:

	<u>US\$</u>
Gross cost of training	4,400,000
<u>Less:</u> repair and maintenance of roads	<u>2,100,000</u>
	2,300,000
<u>Less:</u> repair of equipment	<u>1,200,000</u>
NET COST	US\$ 1,100,000
	=====

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Thus, 75% of the training costs were offset by the value of productive work.

2.1.3.3 Counterpart Instructors

Twenty-five candidates were chosen from amongst the best trainees as follows:

General Mechanics	5
Diesel Mechanics	8
Automobile Electricians	5
Road Supervisors	7

They received technical training in Zaire, followed by intensive instructor training at the Central ORT Institute in Geneva. Each was then attached to a private company in Europe to gain broader experience. On their return, they were assigned to instructor posts in the project. All of them are today assigned to positions for which they were trained.

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2.1.4 Observations

The observations of the Project Manager in his Final Report included the following:

- Reorganization of the Roads Department during the project changed the goals and reduced effectiveness.
- The training period for some technical fields was insufficient.
- An insufficient number of trainees were provided with knowledge of French.
- Retraining of operatives used to obsolete methods was less effective than training new, carefully selected candidates.
- Provision of local funds for the project was often inadequate.

These critical comments should be seen in the context of a training program which achieved nearly double the contract targets, Training Production Units handed over to local staff exactly on schedule, and the rehabilitation of roads and equipment on a scale that offset 75% of the cost of the training program.

2.1.5 Follow-up

Following the completion of the original ORT project in January 1975, a new project for maintenance and management of the Road Department's equipment started in 1975 and continues at present. Six Regional Maintenance Centers and spare part facilities are being managed. A pilot road maintenance training brigade is also included. Fourteen ORT specialists are assigned to this project.

2.1.6 Note

The Zaire project has been described in some detail, as it embodies most of the principles applied in other countries. The description of other country programs will be briefer.

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2.2 CHAD

Chad is a land-locked country to the south of the Sahara desert, with an area of 1,300,000 square kilometers and a population of four million. Only two rivers flow all the year round, in the south, which has reasonable rainfall and savannah woodland. From the center to the north is a transition from dry grassland to pure desert.

2.2.1 Project Description

ORT's current project in Chad is for the Ministry of Public Works and was started in August 1975. Four ORT training specialists are working out of a training center, created by ORT, in N'Djamena in a program which aims at training approximately 150 road maintenance personnel, including supervisors, mechanics, and equipment operators.

2.2.2 Results

A large amount of training material has been prepared and 75% of the training targets have currently been achieved.

2.2.3 Future

A Mechanical Construction Unit has been in operation since November 1976. It has the following equipment:

- 1 Bulldozer
- 1 Wheeled Front-end Loader
- 2 Pneumatic-tired Rollers
- 2 Graders
- 4 5 m³ Trucks
- 2 Water Tank Trucks (9,000 liters)

This Unit has reconstructed 83 km of road from Bongor to Guelengdeng and a 2 km airstrip at Bongor.

Discussions are underway for extension and expansion of the project to include a larger training center and two further Training Production Units for reconstruction of a number of main roads.

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2.3 TANZANIA

Tanzania is on the East Coast of Africa, just south of the equator, with an area of 945,000 square kilometers and a population of 15 million. It contains the highest point in Africa, Mount Kilimanjaro (5,950 m) and the lowest, the floor of Lake Tanganyika (358 m below sea level). The country has adequate but irregular rainfall, with no real extremes

2.3.1 Project Description

The project is designed to support and strengthen the road maintenance organization of the Ministry of Works, Tanzania, and is financed by the World Bank. It involves road reconstruction and the maintenance of all roads in southern Tanzania, as well as the training of a substantial number of Tanzanian staff. The road system includes many kilometers of bitumen-surfaced main roads as well as a network of gravel roads. The actual construction and equipment for maintenance are financed directly by the World Bank.

The three-year contract started in December 1976, and the ORT staff are responsible for supervising and directing the work with their Tanzanian counterparts.

The ORT technical assistance team is composed of the following:

a)	Maintenance Manager	1	(Project Leader)
b)	Road Maintenance Engineers	6	
c)	Workshop Managers	5	
d)	Spare Parts Specialist	1	
e)	Training Coordinator	1	
f)	Instructors (Roads, Mechanical, Equipment Operator)	5	
g)	Premix Superintendent	1	
h)	Quarry Superintendent	1	
	TOTAL	<u>21</u>	

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2.3.2 Results

Road maintenance for the huge area of southern Tanzania is a major task. The first six months of the Highway Maintenance Project have been devoted to:

- commissioning earthmoving plant which had been delivered and not used;
- preparing a major purchase of spare parts for new and existing plant;
- setting up courses and equipping the training school at Morogoro;
- . revising the existing road maintenance structure and establishing a team of Tanzanian counterparts;

starting the major reconstruction of failed sections of the Tan-Zam Highway.

2.3.3. Future

The second phase of the project to cover the northern half of the country is at present under active consideration.

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2.4 NIGERIA

Nigeria has an area of 924,000 square kilometers and a population of more than 50 million, the largest in Africa. It has high temperatures and rainfall varying from very high at the coast to moderate in the north.

2.4.1 Project Description

The ORT training project is part of a very much larger Road Maintenance management contract between the Nigerian Federal Government. ORT has a staff of seven in Nigeria, including a Training Coordinator and specialists in road maintenance, equipment operation and mechanics.

2.4.2 Results

Training centers are established in Lagos and Benin, and considerable quantities of training aids have been produced. At Benin, approximately 15 to 20 roads overseers, 20 equipment operators, 15 mechanics and 20 storekeepers are being trained. The training center has its own equipment with which roads in the vicinity are maintained.

2.4.3 Future

The training centers are now well-established and trainees are available so that training is expected to get into full swing in the next few months.

A new center will be created by ORT, in collaboration with Peugeot, for the training of plant personnel in automobile assembly. This center will provide training to 120 persons per month.

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3. PROJECT DESIGN AND IMPLEMENTATION

Upon identification of a need for training by the Ministry of Works and its Roads Department, often the next step is to obtain financial support from a donor agency. At this stage, ORT may be invited to discuss outline Terms of Reference, and a contract may be entered into for a Study Mission to carry out a survey of manpower needs in the Roads Department concerned. The Study Mission usually includes a specialist in training organizations, transfer of knowledge and program scheduling, and another specialist in road maintenance training. The Mission will normally spend four or five weeks on the survey in-country and five or six weeks in Geneva writing the report in consultation with ORT's headquarters team.

This Chapter outlines the procedures from Survey to Evaluation.

3.1 PROJECT DESIGN

The Survey carried out by the Study Mission will be the basis for the subsequent Project Design. It is essential that the Ministry of Works and the ORT Survey Team clearly agree upon the Terms of Reference of the Study.

3.1.1 Field Survey Implementation

3.1.1.1 Educational and Training Institutions

The Study Team will attempt to determine for all relevant educational and training institutions:

- administrative structure
- technical fields covered
- geographic origin of student body
- admission and graduation standards
- certificates or diplomas and their relevance to the job market.

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3.1.1.2 Manpower

An inventory is compiled of the productive manpower available to the Roads Department for each of the following divisions:

by level:

- highly qualified
- qualified
- semi-qualified
- without qualification

by categories:

- administration and management
- execution level:
 - superintendents
 - foremen
 - operators and drivers
 - mechanics
 - stores and clerical

Also, manpower potential in the same field will be determined from:

- traditional or technical schools) with indication of number
- other training institutions) and levels of students

3.1.1.3 Organizational Data

The following areas will be covered:

- General organization (organizational chart and job descriptions)
- Complete inventory of equipment and machinery used for production and maintenance purposes:
 - numbers, capacity, specification
 - age, and if useful, history
- Investment plans for future equipment
- Training facilities and teaching resources existing at present:

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- number of centers and schools
- frequency of courses and their duration
- number of instructors
- results and impact of such facilities

3.1.2 Analysis of the Data Gathered

After completion of the field visit, the Study Team returns to ORT's Geneva headquarters where it reviews the data with senior office staff. The synthesis of these findings constitutes the Preliminary Report which is sent to the Government and often to the international organization participating in the funding of the project.

3.2 THE SURVEY REPORT

The Survey Report is usually divided into five main sections:

- 1) Recommendations
- 2) Conclusions
- 3) Findings
- 4) Proposals
- 5) Annexes

3.2.1 Recommendations

A summary listing of skilled manpower needs of the Roads Department, divided by categories and levels, is highlighted in this section. Recommendations focus on the design and objectives of the training program, and include reference to:

- Policy
 - i) upgrading existing training facilities and/or creating new ones
 - ii) orientation of training program to practical (on-the-job) or institutional (long-term) training, or both
- Strategy
 - iii) priority determinations
 - iv) long-term objectives and program

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- Tactics
 - v) short-term objectives to be achieved
 - vi) intensive programs - specially designed effort in the briefest time to produce immediate results in a particular skill sector.

3.2.2 Conclusions

The Conclusions identify the gap between the manpower skills currently available and those necessary for:

- satisfactory current operation
- replacement of departing staff
- expected expansion of activities.

This information is illustrated by charts, i.e.:

$$\text{Needed} - \text{Available} = \text{To be recruited and trained or retrained}$$

Here, two situations might prevail:

- a) The manpower available is in itself insufficient. In this case, a double-action program is needed: retraining and upgrading of existing personnel, and, at the same time, recruiting and training new people.
- b) The existing manpower is available in sufficient numbers, but there is a gap in skill levels. Here the program will be devoted entirely to upgrading the general level of available personnel to narrow the gap.

3.2.3. Findings

This section begins with a summary including:

- a) Overview of present national Roads policy and its relationship to skilled manpower needs.

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- b) Analysis of presently available skilled manpower.
- c) Overview of available and needed training facilities.

The Findings include appropriate organizational charts, job descriptions and categories of skills, a description of the Roads Department's past performance, and future expansion plans and recruitment policies. Information related to equipment available and ordered is also included in this section.

3.2.4 Proposals

This part of the Report is directed toward the training program and includes an estimate of what is needed to carry out the program. This will include both expatriate and local staff, equipment, educational aids and methodology. Also covered are the time frame of the training program and a rough budget estimate. This data is presented in the form of an Operations Plan which covers the Conclusions and Recommendations of the Preliminary Report.

3.3 FINAL PROGRAMMING REPORT

The Preliminary Report is submitted to the interested parties and consultations with them will determine the final shape of the project, the basic objectives it is to achieve, and the budget within which it must be carried out.

With the assistance of the technical and professional staff of ORT's Geneva Head Office, the Study Mission will produce the Final Programming Report, which provides the details of project implementation in relation to objectives desired within the allocated time frame and budget.

Each Programming Report contains, in addition to the five main parts of the Preliminary Report, a more detailed Plan of Operations. This is integral to the Terms of Reference of the service contract between ORT and the Ministry of Works. It consists of four principal divisions:

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- Project objectives
- Timetable of activities and Methodology
- Staff, Equipment, Training Aids and Logistics
- Budget.

3.3.1 Project Objectives

The Recommendations of the Preliminary Report, as modified by the discussions with the interested parties, constitute the project's objectives.

The elements of each step, i.e., training, retraining and/or upgrading, the number of courses and participants, use of audio-visual and other teaching aids is detailed in this section.

A top priority is the setting up of a Central Training Unit and the training of local instructors who will staff this Unit. These local instructors will work side-by-side with ORT trainers and acquire know-how and experience for the purpose of progressively taking over all administrative and program responsibilities.

3.3.2 Timetable of Activities

The schedule for each different and successive step is arranged in tables showing the development of the complete program and how each step meets a specific purpose and leads to a following step.

3.3.3 Logistics

The logistics needed for the execution of the project, classrooms, equipment, local personnel, etc. are indicated on the timetables and are budgeted separately. The support to be provided by the Geneva main office, including training aids, audio-visual equipment, etc., is also indicated.

A financial estimate is made of the logistic support costs of the project and is divided into investment expenditure and operating expenses:

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3.3.4 Budget

The Plan of Operations showing the number of ORT specialists needed in the field and the Timetable indicating the dates of their arrival and length of service provide the basis for computing the man/month cost table for ORT personnel. Added to this cost are the charges for Geneva head office backstopping, international travel, consultant fees, and other expenses incurred at the Geneva end of the operation.

3.4 PROJECT IMPLEMENTATION

The Programming Report is submitted to the interested parties and, when approved, it provides the basis on which a Contract is signed between ORT and the Roads Department or Ministry of Works.

The Contract includes the obligations of the Ministry, such as:

- assuring that a sufficient number of trainees will be available at the skill level previously determined;
- providing ORT specialists with the status and means to ensure their most effective service;
- providing buildings, classrooms, training center, vehicles, equipment, etc., as detailed in the logistics tables;
- completing steps a), b) and c) within the time frame outlined in the calendar chart;
- making all local currency funds available to the project on the dates required.

During this Intermediate Phase, preliminary activities are carried out by the Geneva office, i.e.:

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- recruitment of the ORT specialists;
- choice of project leaders;
- refining training program curricula, detailing facilities required.

Immediately following Contract approval by all parties, implementation proceeds as follows:

3.4.1 At ORT Headquarters

- C.V.s of candidates for ORT specialists and project leaders are sent to all interested parties;
- Orientation seminars are carried out for the approved specialists and trainers;
- Instructions and directives are given to the project leaders;
- ORT team members are sent to the field according to the timetable.

3.4.2 In the Country where the Project is Carried Out

- Arrival and installation of ORT staff;
- Distribution of tasks among project leaders.

3.4.2.1 Project Manager and Training Coordinator

- Contacts with the Ministry;
- Selection of trainees and counterparts.

3.4.2.2 Administration

- Checking of buildings and housing designated for ORT occupancy.
- Procurement of equipment/material;
- Selecting local personnel for assignment to the project.

3.4.2.3 Training Studies Specialist

- Preparation of program studies;
- Final programming of first steps.

3.4.2.4 ORT Training Specialists

- The Training Coordinator supervises the training specialists;
- Each specialist reviews his part of the training program;
- The specialists also participate in the selection of trainees and local instructor training.

3.4.2.5 Preliminary Steps before Training Courses Begin

- Seminar for upgrading of local trainers;
- Final checking by the Project Manager and his staff of:
 - classrooms
 - training equipment
 - courses and technical documentation
 - results of tests made for trainee selection

3.4.3 Start-up of Courses

The training program begins.

3.4.4 Other Procedures during Implementation

3.4.4.1 At Geneva Central Office

- Logistic Support:
 - procurement and shipping of documentation and equipment;
- Technical Support:
 - inspection trips;
 - advice on methods and objectives;
 - evaluation of results, amendment of objectives and/or methods.

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3.4.4.2 In the Country Where the Project is Carried Out

- Revising the quarterly and yearly work schedules in consideration of progress made and new findings. Particular attention is given by the Project Manager to the progress achieved in staffing with fully-trained local personnel.
- Quarterly reports are submitted with the following main features:
 - Achievements and how they compare with planned objectives:
 - number of people trained
 - skills, sectors and professions involved
 - number of man/months spent in relation to schedule.
 - Work schedule for the last quarter and for the next quarter and how they fit into the Timetable Chart.
 - The conclusions of the Report will comment on any gap between results and objectives. It will include suggestions as to how such gaps can be corrected and what improvement can be introduced into project implementation.

3.4.4.3 On-the-job Training

With the agreement of the Roads Department, ORT specialists can contribute to the integration of trainees into a normal work situation by organizing pilot crews made up of trainees, or by restructuring production units to include trainees.

The impact of such trainee participation is monitored and carefully analyzed, since such experience will constitute one of the most important criteria to be used in the final evaluation of the Training Program.

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3.4.5 Phasing Out

There are four criteria which determine when assistance should be stopped:

- A permanent training structure has been created.
- Training methodology has been devised, applied and proved efficient.
- Project's first objectives have been achieved.
- Counterpart trainers have been prepared and integrated into the permanent structure.

The Project Manager will be constantly conscious of the above and, with the help of his staff, will endeavor to create this situation during the project's life span.

3.5 EVALUATION

Evaluation constitutes a permanent and continuous element in all training projects. Progress indicators are built into all phases and steps of the program so that the Project Manager can regularly assess individual unit and overall performance. Expected outputs are clearly defined so as to make the appraisal realistic.

During the course of the Project, internal evaluation of individual trainee progress is carried out on a weekly basis. Furthermore, Progress Reports for each trainee are established quarterly to record his class attendance and quality of participation. Drop-out cases are examined carefully. Work performance of graduate trainees is appraised "on-the-job" to determine changes in their approach to maintenance and production.

Evaluation of the Project's achievement is contained in the Final Report. This appears in the form of a comparison between the indicated achievement and the project's original objectives -- quantitatively and qualitatively.

In addition to trainee evaluation, the process of establishing or strengthening a Training Structure with a staff of professionally capable local managers and trainers must also be evaluated. Special emphasis in this regard is placed on assessing institutional results such as:

- whether the local institution is less dependent on expatriate staff;
- how soon local staff will fill all key posts.

External evaluation should occur on an annual basis for the first three years after completion of individual training cycles. It is obvious that

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the evaluation procedures can be carried out only with the assistance of the host country. While the Training Program is still on, the Project Manager is expected to introduce a reporting procedure for the Roads Department which it can continue to use after the departure of the ORT team.

Another vital aspect of external evaluation is that of appraising the Project's impact on local conditions. Questions that must be answered are:

- To what degree has the shortage of skilled manpower been met by the Project?
- Have trainees been employed in the profession they have been trained for?
- Has the Project beneficiary solved some of its production problems and achieved an improved distribution and use of its manpower as a result of the Training Program?

The ORT team maintains its responsibility to assist the Ministry and the Roads Department to answer these questions. The answers determine the justification of the Training Program, especially with regard to its continuation and/or modification.

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4. OBSERVATIONS AND RECOMMENDATIONS

The demand for supervisors and for manpower in the independent countries of Africa is far greater than the capacity of government or private training institutions. Nowhere is this more evident than in the field of Road Maintenance. Experience throughout Africa shows that, given the necessary finance, it is comparatively easy to get new roads built using international consultants for design and international contractors for construction. However, few African countries have been able to obtain effective maintenance of the roads once constructed.

The reasons for this are various. The countries have been independent for less than 20 years. During the first part of that period, the emphasis was on the building of an infrastructure, including a road system. Loans for such construction were readily available from the industrial nations, especially as the construction involved the use of outside contractors or equipment bought from the industrial countries. Initially, little maintenance was carried out, but the surfaces began to wear as traffic was increasing substantially. In some African countries, traffic growth rates of 10% per annum are still found. Ten years ago, many African countries and the donor agencies realized that the investment in roads was quite literally disappearing.

Unfortunately, maintenance organizations in many countries had been neglected in the understandable haste to develop and build. Furthermore, during the colonial era, Africans were generally not allowed to get beyond certain levels, such as junior supervisor, assistant mechanic or "spanner-boy". Thus, when many Europeans left the countries after independence, a large gap was left. The massive training effort of the last few years has been an effort to close the gap and provide the necessary skilled manpower for Road Maintenance activities. This has been accompanied by an essential investment of money and interest in the subject of Road Maintenance.

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It should be emphasized that the battle is far from won. ORT's experience in a variety of African countries has revealed this fact quite clearly. It has also revealed that trained and experienced manpower is the major bottleneck.

As a result of ORT's experience, and from a concern to see the available international and local resources used most effectively, the following observations and suggestions are made.

4.1 TRAINING AND MANAGEMENT

Trained and skilled workers can only be effective in an organization which is well enough managed to use their skills effectively. Senior engineers need to think carefully about how the newly-trained workers will be used, where they will be used, what advantage can be taken of extra skills. Provision must be made for equipment, tools and workshops. The organization itself may need to be examined and, if necessary, adjusted to take advantage of what training can do -- and adjusted for what training cannot do.

Managers of Roads Departments should be closely involved in designing the Job Specifications of the senior posts for which training is required, as they will largely define the detailed training syllabuses.

4.2 TRAINING OF SENIOR STAFF

Often long-established senior staff are neglected when training is considered. It is useless to introduce new methods to mechanics if their foremen have not heard of them. In fact, any training program should start with the most senior management and supervisory staff and work from that level through the system.

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4.3 TRAINING AND JOBS

Training is a process whereby workers are given skills or their skills are improved in order to equip them for a particular job. Training is not education. We should not teach Newton's Laws to a mechanic unless they can be shown to help him in his job. There is a limit to what can be achieved by training. No short training course given to an adult is likely to alter his personality or character. This emphasizes the point that selection must be carefully carried out, especially for staff who are destined for supervisory jobs. Furthermore, trainees should be clearly informed of the scope of their training and its targets in relation to the individual and the organization.

4.4 TRAINEES

If training is to be effective, not only must the program be well designed and expertly run, but the trainees must be carefully selected. Before training starts, clear decisions must be made on the extent to which retraining of existing staff can be effective and how far it can be taken. In the interests of staff morale, retraining should be given first priority.

However, in many cases, recruitment of new staff is necessary. The opportunity should be taken to specify as precisely as possible the qualities required in the trainees and selection should be as objective as possible. Trainees should be selected wholly on merit or the whole program can be adversely affected.

The program formulation should focus on training according to the job requirements. Nothing is more demoralizing than to be trained to a high level and to find no suitable post available, even though the work required of the trained person may be demanding. Examples exist of this happening to trained university graduates, as well as many at a lower level.

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4.5 MANPOWER SURVEY

Before any training program is undertaken, it is essential that some kind of study is carried out which relates the needs of the Roads Department to its current and future work load. Chapter 3 of this paper describes ORT's procedure in this area and it is a mistake to think that this stage can be ignored or not taken seriously without adversely affecting the program.

Roads Departments and other could help themselves in this respect if department and section heads were required to keep accurate records of their manpower and to regularly assess their needs in relation to work load.

If a training organization such as ORT is to be used, it is obviously a great advantage to have that organization involved in the survey stage to ensure early agreement on the existing manpower potential

4.6 MECHANICAL MAINTENANCE

Very often the training of mechanics to maintain and repair Roads Maintenance equipment is a critical part of a comprehensive training program. It will be noted that in ORT's Zaire program, the biggest increase in training was for mechanics. The repair and maintenance of very expensive and increasingly expensive equipment is placing a great burden on nearly all Ministries of Works.

At least two conclusions may be drawn which are not strictly related to training. One is that, where possible, the use of equipment should be avoided and labor-intensive methods explored. This is obviously not practical in the case of heavily trafficked main roads, but for access and feeder roads, it should be carefully examined.

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It is also observed that many countries still have a single central government agency for vehicle and equipment maintenance and repair. With the vast growth of vehicle usage, this is probably not practical and creates an organization too big and unwieldy for the countries to manage. It would in many cases be more useful for major users to have their own organization and for the central workshop to service those Ministries too small to be self-contained.

4.7 TRAINING METHODOLOGY

There are two distinct methodologies based either on a large fixed Training Center or on mobile Training Production Units.

The staff Training Department in Kenya studied by ORT for the Swedish International Development Authority and the World Bank in 1975, is a good example of the fixed Training Center concept. It operates in a country which is fairly centralized, with a good transport system. For the new Rural Access Road Program in Kenya, Training Production Units are in use.

The ORT program in Zaire, described in Chapter 3 of this paper, was probably the largest program in Africa using Training Production Units. This system was developed very successfully in a vast country having considerable transport problems.

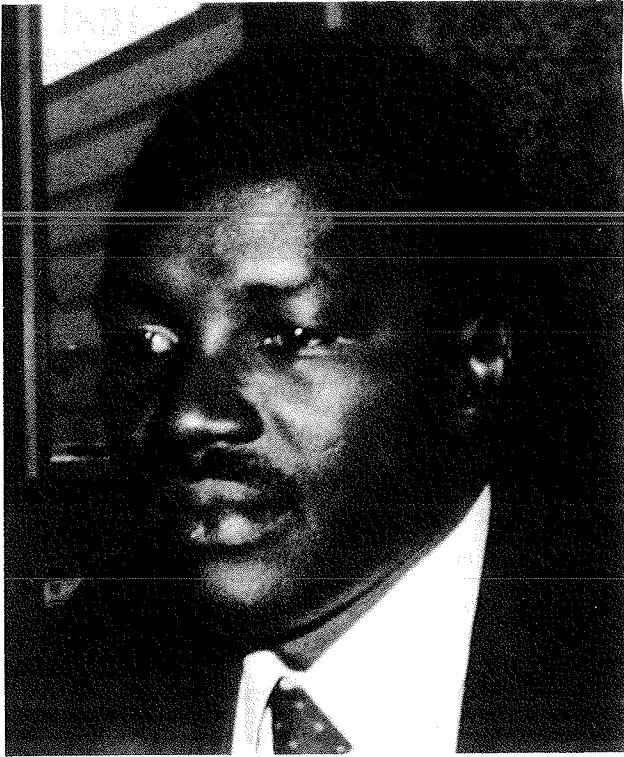
The majority of programs will have a combination of Training Centers and Training Production Units. Apart from the practical advantages of carrying out training in realistic on-the-job conditions, the major advantage of production which offsets the high cost of training should be noted.

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4.8 COUNTERPARTS

It should be the objective of any externally staffed training program to create a team of local instructors who are competent to continue the program at the end of the contract period. This means that the Roads Department has to be prepared to select some of its best staff to become counterparts to the expatriate instructors. Ideally, those chosen should also be given some incentive, such as a higher grade.

Unless good counterparts are provided early in the training program, there will be little chance of the expatriate team leaving behind a working unit.



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Michigan Seminar
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1978

PRINCIPAL FINDINGS OF TRAINING RESEARCH ^{1/}

by

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INTRODUCTION

Having completed thirty years of training efforts in the highway field, it is time to summarize what we have learned. Training being an unusually difficult pursuit, it clearly is time to single out factors critical to success in the area.

Large, Decentralized Forces

This discussion is limited to training large, decentralized employee forces. Training relatively few employees, particularly when they are located in one building or can quickly be assembled in one location, presents very few problems. Training several hundred or thousands of employees scattered over large geographical areas is another matter—and is the topic addressed here.

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^{1/} This paper was prepared for presentation to the VIIIth World Meeting of the International Road Federation held in Tokyo in October 1977. It refers to highway agencies only—the Tokyo Meeting being for highway officials only. The concepts presented apply to transportation departments in the United States as fully as they do to highway departments in other countries.

Training, Not Education

This discussion is limited in another way as well—to training as distinguished from education. As indicated in Figure 1, we are concerned here with completing highway operations satisfactorily—patching asphalt, cleaning ditches, operating motorgraders, tuning engines, testing soils, preparing construction plans, supervising construction contractors, managing construction and maintenance operations. Certain employees also have education needs, many of which are critical to highway operations, but they must be dealt with another time.

Figure 1

TRAINING AND EDUCATION

It is necessary to differentiate between training and education.

Training:

1. is restricted to work methods, workmanship requirements, materials mixes, crew sizes, equipment complements, safety practices and similar subjects attributable to one employer;
2. covers the subject matter in full detail—with no historical or theoretical references; and
3. must result in satisfactory performance on specific work assignments.

Education:

4. covers histories, theories, principles, key individuals involved in the past, opposing viewpoints over the years, key stages in the development processes, and dates; and
5. prepares individuals, in pre-training ways, for employment with any of several potential employers.

TWO WAYS TO TRAIN LARGE FORCES

The main training approaches attempted over the years are listed in Figure 2. Only two of them—train the supervisors first and let them train their employees, and train the employees directly, using special instructors—have potential for consistent success. No other options really exist.

Figure 2

MAIN APPROACHES TAKEN TO TRAINING LARGE FORCES

Several approaches have been attempted in training large numbers of employees. Only the last two below are workable options.

1. Provide for on-the-job training;
2. Send employees to adult education classes or vocational schools;
3. Have employees train themselves;
4. Train the supervisors first, and have them train their employees; and
5. Train the employees directly, through special instructors.

On-the-Job Training Approach

The on-the-job training approach is listed because the term is used so often. It means different things to different people—ranging from letting each employee train himself, providing manuals and other instructions as aids to self-training, having one employee train another, and having supervisors do the training. It also means learning-by-doing, which is fundamental to all successful training. Yet, if large numbers of employees are to perform certain tasks in essentially identical ways, the learn-by-doing concept must be preceded by some type of formal training. And the formal training must be provided by regular supervisors or special instructors.

Adult Education Approach

The adult education approach is listed in Figure 2 only because it has so frequently been tried as a training technique. It belongs in the education category, and works very well as an educational approach. It has been an object failure in meeting training needs for reasons that will become clear as this paper moves along. The main reason, however, is that educators are not prepared to teach work methods, workmanship requirements, crew sizes and other matters attributable to any single employer.

Employee Self-Training Approach

The self-training approach takes two main forms: observe and copy, and programmed instruction.

The observe-and-copy technique certainly is the most widespread of them all. It results in excellent training whenever the trainee is copying a master, particularly when the master also acts as a coach. On the other end of the scale, it results in counterproductive training whenever work methods being copied should be replaced or significantly improved. The prevailing result, of course, is so many variations in performance as to represent no training at all.

Programmed instruction (also called "self-study" or "self-instruction" courses) has greatly advanced the self-training technique. Work methods, workmanship requirements and related subject matter are set forth in specially prepared training texts or audio-visual courses. The basic idea is to make high-quality, fully consistent training available to anyone interested in completing it. And the technique has many highly attractive features, such as: self-pacing—letting each employee go as rapidly as he can through each segment of the training, or as slowly as necessary; self-scheduling—permitting each employee to take training whenever time permits, and to take up regular work assignments whenever necessary; and on-site training—permitting each employee to be trained at or near the job location.

That programmed instruction works has been documented many times, with relatively small, highly motivated groups. But, the approach has been largely unsuccessful with

large, decentralized forces of maintenance, construction inspection, and materials quality control forces. The technique rarely works by itself. Supervisors or special instructors must be active in the total process: assign the training in segments, supervise the "work," discuss significant points, and provide practice sessions. In short, programmed courses are highly effective with large forces—when used as part of the train-supervisors-first or the use-special-instructors approach.

Train-Supervisors-First Approach

One person can train another only after learning how to do the work as it should be done. Large numbers of supervisors, working at it separately in numerous locations, can obtain reasonably uniform training results only if the materials they use are pre-packaged. And large numbers of supervisors will, on the average, make a relatively poor instructor force—unless the training materials are complete and easy to use.

Eight training techniques that permit courses to be prepackaged for operating supervisors are identified in Figure 3. While the descriptions are brief, take special note of three things: (1) Work methods and workmanship requirements are shown through various series of diagrams, sketches and photographs; (2) The point of each diagram, sketch and photograph is explained directly to the employee—by way of a cassette tape or printed paragraph; and (3) The training consists of seeing, hearing and doing. Since people learn best by doing—the underlying principle of on-the-job-training—all techniques must include demonstrations and practice sessions.

Supervisors are trained to use the packages of training materials properly. Training in the work methods and other topics covered is an integral part of the instruction.

Train-Employees-Directly Approach

Maintenance superintendents rarely can train their own equipment operators regardless of prepackaging. They cannot themselves, as a rule, operate the equipment, precluding essential demonstrations.

Figure 3

TRAINING TECHNIQUES THAT PERMIT PACKAGING OF
COURSES FOR SUPERVISORS

1. Wall diagrams—large sketches identifying lubrication points on equipment and lubricants to be used, or steps to be followed in servicing batteries. Supplemented by discussion outlines or discussions on audio tapes.
2. Flip charts—series of sketches depicting simple work methods and workmanship requirements, usually with corresponding discussions recorded on cassette tapes.
3. Slide-tape sets—color photographs, on 35mm slides, depicting work methods steps in proper sequences; difficult points depicted in simple graphics; a discussion of each slide recorded on a cassette tape.
4. Filmstrips—color photographs of work methods and workmanship again, but larger numbers for greater clarity. Variable speeds of presentation, from still shots to motion. Corresponding discussions recorded on synchronized cassette tapes.
5. Photograph manuals—color pictures and sketches of work methods properly sequenced in manuals. A discussion paragraph to accompany each photograph and sketch.
6. Discussions—question-and-answer sessions with the supervisors leading the discussions. Always preceded by one or more of the presentations above. Supervisors are given discussion guides.
7. Demonstrations—sessions during which supervisors show employees how the work is to be done, using actual materials, tools, equipment and reports. Trainees participate as necessary. Supervisors are given detailed instruction manuals.
8. Practice sessions—employees do the work as shown, discussed and demonstrated. Workbooks are provided for written exercises. Materials, tools and equipment are provided for manual practice.

Since instructors must be able to do the work involved, special instructors must be substituted for regular supervisors. The instructors need only to be very good at the work methods or management systems they are going to teach. They can be taught how to

instruct others. District motorgrader operators, crane operators, quality control technicians and comparable specialists meet the needs.

Training packages used to support special instructors are much the same as those prepared for regular supervisors—diagrams, slides, filmstrips, cassette tapes, manuals and models.

ORGANIZING THE TRAINING FUNCTION

The three main parts of training are work methods and management systems development, course design and production, and implementation. The principal organizational questions have to do with who should do what.

Methods and Systems Development

Operating officials are accountable for completing work loads within given time frames and approved budgets. Being accountable in that way, they must control the work methods, quality standards and management systems (work load measures, crew sizes, equipment complements, productivity rates, work schedules, information systems, and so on).

If we were discussing education rather than training, the teachers would be responsible for developing topics and exercises from textbooks, research papers and treatises. Since training must be specific—covering each highway agency's methods and systems in complete detail—textbooks and research papers are of no value to training specialists. Only approved work methods and management systems are useful.

From an organizational standpoint, then, operating officials must develop, test and approve work methods and management systems that training specialists will cover in their courses.

Course Design and Production

From the standpoint of operating officials, full control over the major tools used in carrying out work loads should include control over course design and production. If each division chief and district engineer (see Figure 4 on the next page) had a staff of training production specialists, then priorities, production schedules and subject matter coverage would always be consistent with division needs.

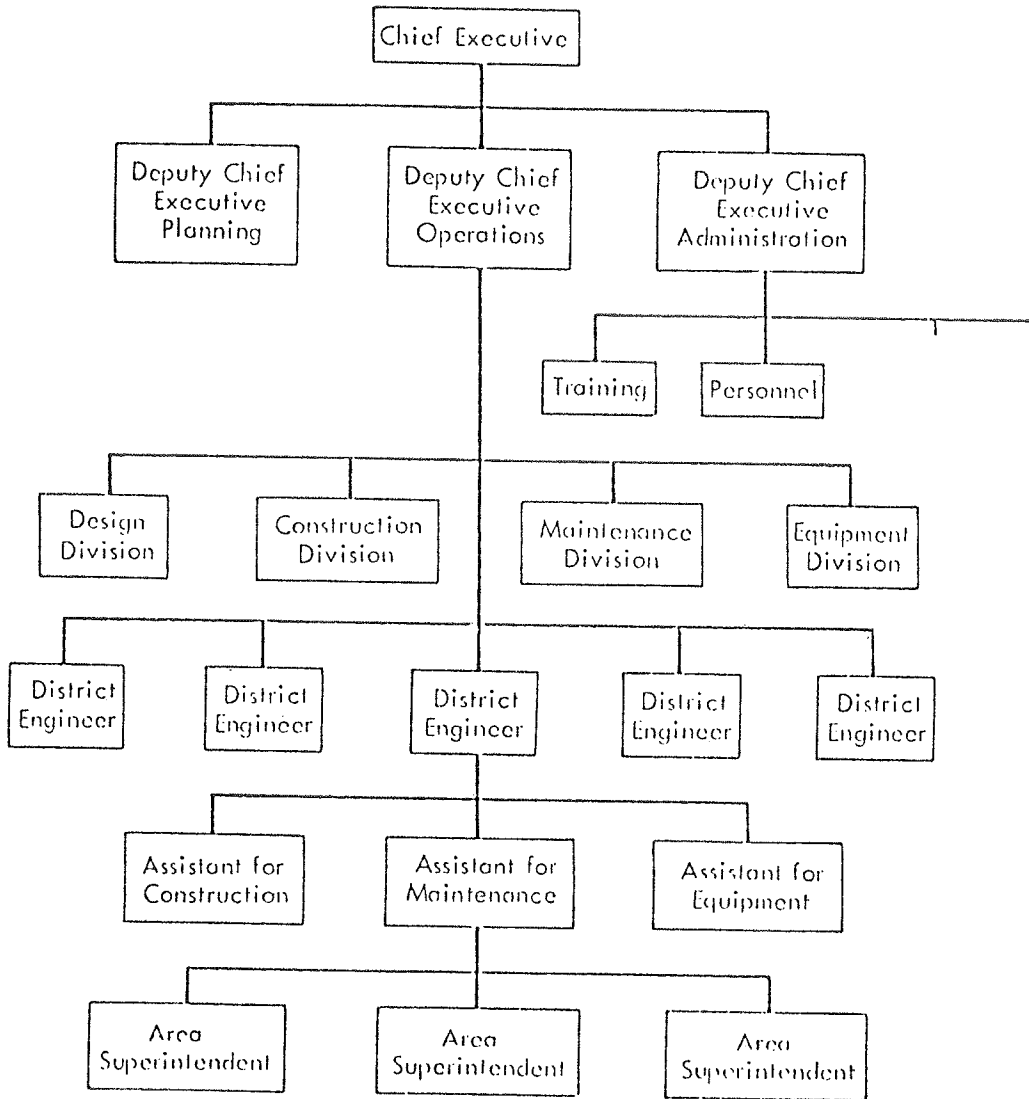
Placing a staff of training specialists in each major division and district would cause problems in supervision. Course and curriculum designs are complex activities, as is course production. Training specialists are scarce, and their development takes years of guidance and experience. Placing a small staff of such specialists in each division, let alone each district, would mean supervision by individuals having limited training capabilities. It seems best to establish one training unit for the highway agency as a whole, thereby permitting a senior training specialist to supervise the group.

Creating one training unit for the agency solves another problem—course duplication and overlap. Many courses are useful in training for design, construction and maintenance employees. If each division had its own staff, some type of coordination setup would be required to prevent duplications of effort.

Figure 4 indicates that the training unit should be placed in the Division of Administration. Such units have been successful as parts of planning divisions, research divisions, and materials quality control functions. The governing consideration is control of priorities; if one unit is to produce courses for design, construction, maintenance and equipment divisions, it should be independent from those divisions. The division heads can serve as a steering committee to hammer out policies, priorities and other matters of mutual concern.

Finally, the training unit is best retained in the highway agency—as distinct from being assigned to some other agency in the government hierarchy such as Central Personnel or Central Administration. The Chief Executive of the Highway Department is accountable for all work loads in the Department. If control over training is lost to the Department, so is control over priorities and all other aspects of it. If control is retained,

Figure 4
TYPICAL ORGANIZATION CHART *



* This diagram is complete enough to serve the purposes of this paper. It represents no existing highway agency.

the Chief Executive can add manpower, set priorities and delivery dates, and enforce training specifications.

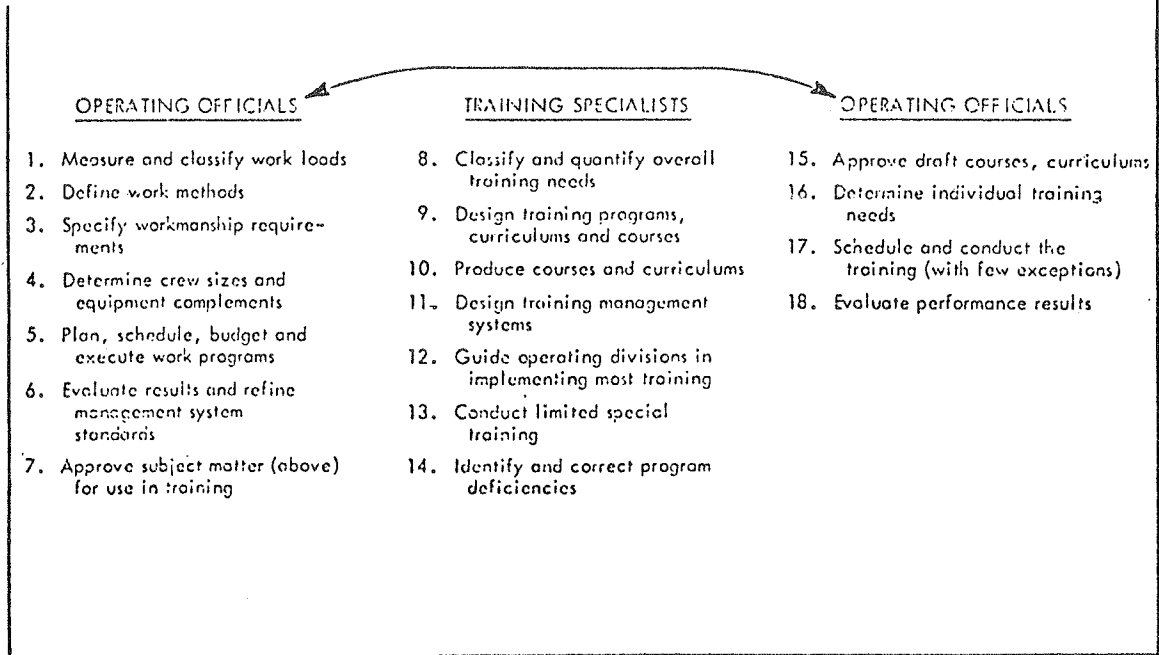
Training Implementation

Traditionally, training specialists have conducted their own training courses. They like to instruct, and they find it difficult to believe others can instruct as well as they can.

The division of responsibilities shown in Figure 5 indicates that operating officials should implement their own training programs. This is in keeping with the principle of giving all responsible parties control over as many tools of management as they can handle.

Figure 5

GUIDE TO ASSIGNING TRAINING-RELATED RESPONSIBILITIES



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Experience has demonstrated that average performance as instructors by regular supervisors is superior to excellent performance by other instructors. There are several reasons for this, two of them being paramount:

- Employees still want to satisfy their supervisors—and will be much more serious about training if it is conducted by their supervisors than if it is conducted by someone else; and
- Operating supervisors must support the training if it is to be effective—and they support it much more fully if they conduct it than if someone else does.

As can be seen, regular supervisors have an advantage other instructors can never have: They are the bosses. More than that, they can schedule the training as it is needed, for employees who need it, and when work loads will permit. And they can follow the training with proper work assignments.

TRAINING COSTS

Training must reduce operating costs—through increased productivity rates and improved quality controls. It can decrease costs only if manpower and equipment needs are reduced, and then only if operating officials make the reductions. Making reductions possible is a training function; making them is an operating function.

Obviously, training costs themselves must be controlled.

Fixed Costs of Training

Buildings and instructors represent the main fixed costs of traditional training programs. The costs of motorgraders, dozers, loaders and other equipment assigned permanently to training centers can be added for equipment-operator training courses.

Decentralizing training implementation to the operating divisions and districts eliminates most of these fixed costs. A small staff of training production specialists must be financed, together with office space, cameras, projectors and similar equipment. Small training centers can also be useful for advanced equipment-operator courses, advanced mechanic training, surveyor courses, and related specialty training. (It can be less expensive to bring small groups to training centers than to send special instructors to all districts.)

Under the decentralized approach, each district must be provided with slide projectors, screens, cassette-tape players, and filmstrip projectors, plus copies of all courses. While such costs are considerable, they amount to small fractions of training-center costs.

Variable Costs of Training

Employee travel expenses and salaries represent the main variable costs of training.

When thousands of employees must be trained, the costs of travel and subsistence under the training-center approach can be prohibitive. They can be so high that the numbers trained must be severely restricted.

The salary cost for any one employee is the same regardless of where training takes place. Total salary costs increase, of course, as the numbers trained increase—and those numbers go up sharply with decentralized training. Presumably supervisors must train their employees in any case—with prepackaged courses or without—making the salary-cost question academic.

Benefit-Cost Relationships

The higher training costs are, the more difficult it is to offset those costs through increased productivity rates and improved workmanship.

Centralizing course methods and management systems development is efficient. In any case, agency-wide uniformity can be attained no other way.

Centralizing course design and production is also efficient. Having each division develop its own training materials would result in excessive duplication. Having supervisors prepare their own training materials would be the same as no training at all—at least no improvement over leaving all training efforts up to immediate supervisors. They simply do not have the time or talent to produce effective materials.

Decentralizing the administration of training to division- and district-level supervisors, and to special instructors, is efficient. The fixed costs of training centers and permanent instructors are reduced, almost eliminated. And the high costs of employee travel are avoided.

WHAT WE HAVE LEARNED ABOUT TRAINING

This paper has been directed toward training large numbers of employees in decentralized organizations. And it has been directed toward training as distinguished from education.

So, what have we learned about training in the last thirty years?

Key Relationships

Training must be supported by operating officials if it is to work at all. Operating support is lost unless training pays off in terms of improved employee performance. Support is increased if operating divisions retain full control of work methods and management systems, and if those methods and systems are the bases of training.

Training specialists can design and produce courses for operating divisions. This is a specialty function readily delegated by operating officials. But the specialists must avoid making decisions relative to work methods, workmanship requirements, crew sizes and related items of operating concern. If those decisions have not yet been made,

arrangements must be worked out so that they are made by the proper parties. On the other hand, training specialists must retain responsibility for training program design and production. Operating personnel have limited knowledge of current training techniques, and limited time for mastery of them.

Training is supported best when operating supervisors conduct it. Supervisors can delegate this activity to associates or subordinates, but they must make it clear that work will be done as shown in the training courses.

Key Techniques

Operating supervisors can become good instructors—very good instructors. Fully detailed work methods and management systems can be depicted in a variety of ways—including flip charts, color slides, filmstrips and photo-books. Demonstration sessions can be designed for almost foolproof performance by anyone capable of doing the work being covered.

The main finding may be this: Supervisors generally make poor educators; left to their own devices, supervisors try to be educators whenever they are expected to train employee groups. But, supervisors make very good instructors when the instructor role is properly defined, when instructor materials are provided, and when instructional training is provided.

GOVERNMENT OF INDONESIA

INTERNATIONAL
DEVELOPMENT
ASSOCIATION

INTERNATIONAL BANK
FOR RECONSTRUCTION
AND DEVELOPMENT

TRAINING SUPPORT SERVICES

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FINAL REPORT

DIREKTORAT JENDERAL BINA MARGA
Ministry of Public Works and Power
Kebayoran Baru, Jakarta, Indonesia

December 1975

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Chapter One

TRAINING ORGANIZATION

The training organization of Bina Marga and the provincial highway agencies is based on management and training principles. These principles are discussed first below, followed by a description of the organization that has been adopted.

Organization-Related Principles

Bina Marga's training function was organized in accordance with four principles.

Training Is Work

One—Training is work. It must be planned, approved, scheduled, directed and controlled the same as other work, and by the same officials.

Insofar as possible, training should be regarded as a part of all regular work loads. Roads and bridges must be designed, constructed and maintained. The individuals responsible for carrying out these activities must first learn how to do them. Since employees learn to do work best by doing it, the more work and training are integrated, the better will be the results.

Since training is work, the officials responsible for accomplishing the work loads should be responsible for all the efforts involved. If some of those efforts are so specialized that they should be treated separately, the operating officials should retain responsibility for final plans, schedules and controls.

Operational Control

Two—Operating officials and supervisors, being responsible for meeting production objectives, must control the work methods to be used, workmanship requirements to be attained, and management systems to be applied.

The second principle is an extension of the first. Being accountable for getting work loads done, operating officials must control the ways of getting them done. They must design the work methods, establish quality levels—to avoid costs of underdoing and overdoing the work—and design systems through which work loads are to be planned, scheduled, budgeted, executed and controlled. Training specialists cannot be permitted to work these things out for them.

Supervisors Do Training

Three—A person learns best when trained by his own supervisor.

Research has demonstrated conclusively that employees learn best when trained by their own supervisors—provided the supervisors are capable of doing the training.

Obviously, a construction superintendent cannot be skilled in all activities he supervises—motorgrader, bulldozer, loader, distributor, roller, crane, dragline and batch plant operations, for example. Someone else must train his equipment operators. Engineers can train their foremen and crews to repair bases and road surfaces, rebuild shoulders and clean and shape ditches. And they can train technicians to sample and test materials, read and interpret contract plans, and inspect construction results for compliance with plans and specifications.

Since many of the supervisors can be effective instructors only with special assistance, there is need to produce training materials that will ensure their effectiveness.

Training Support

Four—Officials and supervisors support training best when they conduct it themselves.

The fourth principle is an extension of the third. Supervisors must support the training if it is to be effective, and they support it best if they conduct it.

Clearly, if top management officials who direct the work have designed the work methods to be used and the management systems to be applied, and if they require adoption of those methods and systems, the operating supervisors must comply. This is in keeping with the third principle in any case, since supervisors learn best from their own superiors. Just as important, supervisors who train their own employees to comply with official methods, workmanship requirements and management procedures find themselves in concurrence—provided the methods and systems are logical, consistent and complete.

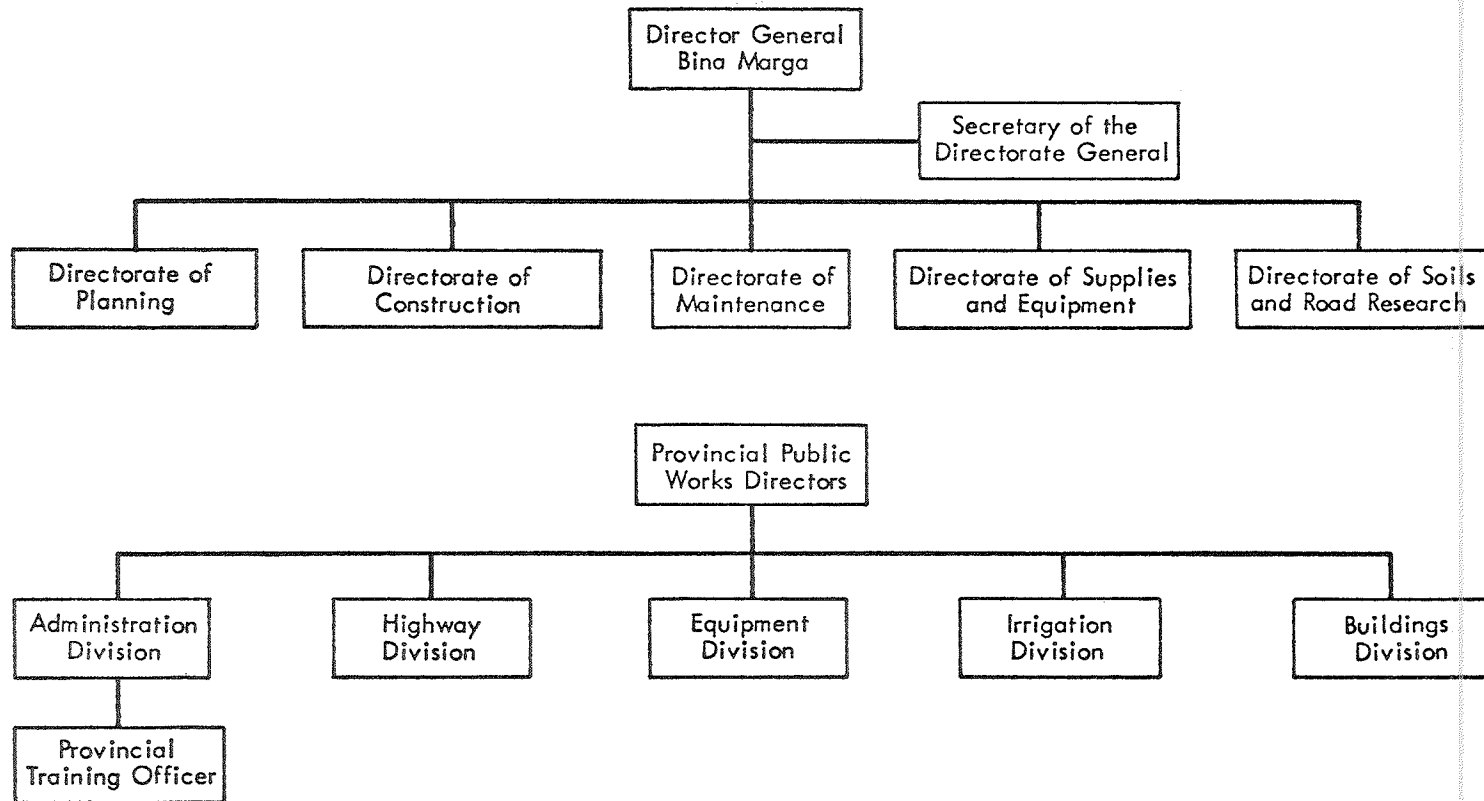
Organization for Training

The organization for training includes the Director General and operating directorates of Bina Marga, plus the public works directors, highway chiefs and equipment chiefs in the provinces. The Secretary of the Directorate General is directly responsible for managing training in Bina Marga, and the directors of administration typically fulfill the same function in the provincial organizations. Both of these organizations are depicted in Figure 1.

The project organization for training consisted of a Steering Committee, a Technical Panel, a Central Training Unit and provincial training officers, as depicted in Figure 2. The current training organization is identical, with one exception: the Coordinating Committee, a permanent part of the Bina Marga organization, performs most functions carried out by the Steering Committee while the training program was being developed.

Figure 1

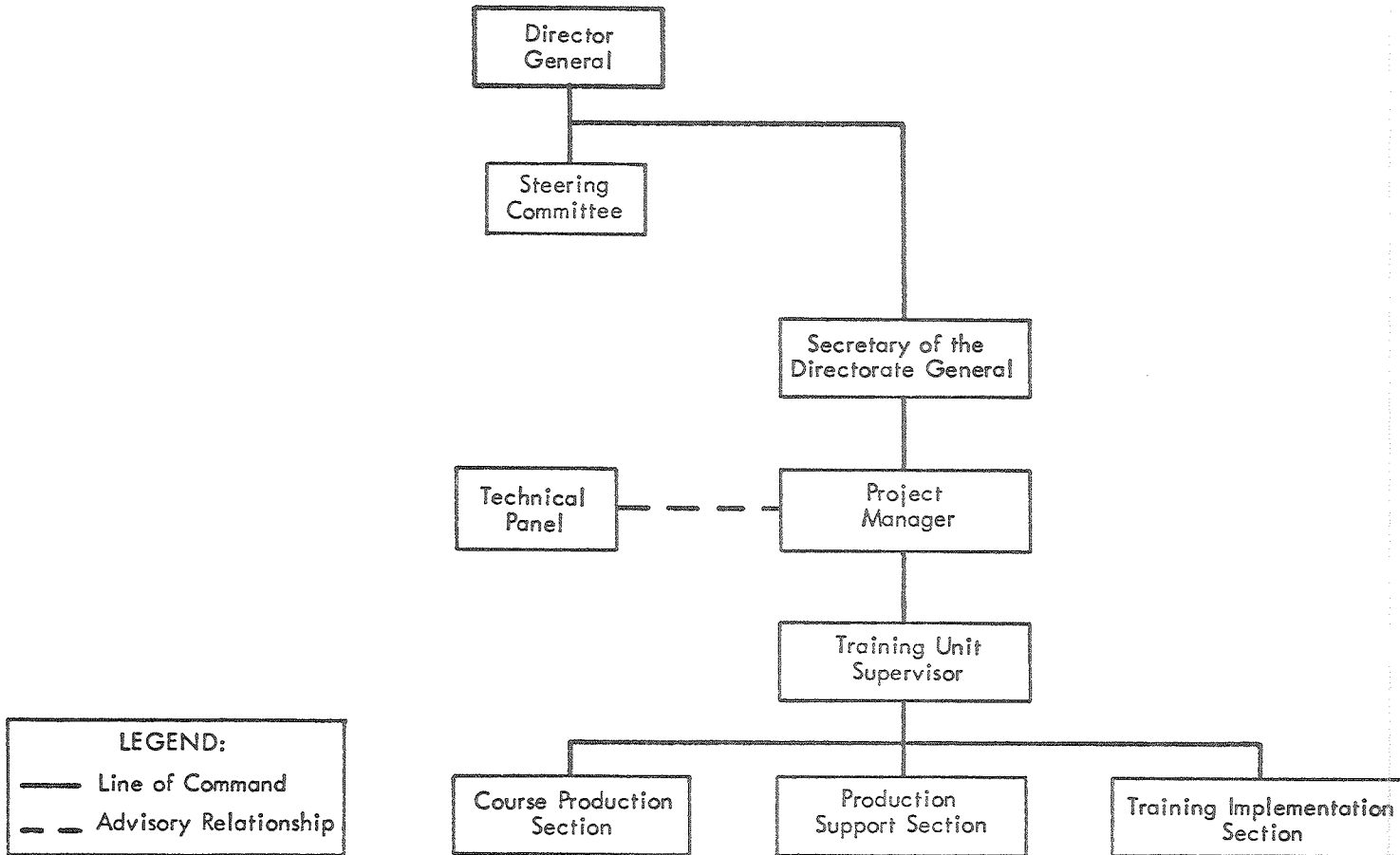
OPERATING ORGANIZATIONS OF THE DIRECTORATE GENERAL
BINA MARGA AND THE PROVINCIAL DEPARTMENTS
OF PUBLIC WORKS



- 4 -

Figure 2

PROJECT ORGANIZATION FOR TRAINING



Director General

The Director General Bina Marga is responsible to the Minister of Public Works and Power for all operations connected with highways and bridges.

In keeping with the training principle, the Director General is, in effect, the chief training officer of Bina Marga. He delegates most of the work, but is himself accountable for both the regular work loads of the Directorate General, and for the training.

Operating Directorates

The Director General delegates all except final responsibilities to the operating directorates shown in Figure 1. He also delegates all except final responsibilities for work methods and management systems design, and for developing manpower to carry out the work in accordance with approved methods and systems.

These directors can properly delegate methods and systems design only to individuals under their full control.^{1/} They must also control training programs. To do otherwise would be to give up major tools required for advancing productivity rates and controlling costs.

Steering Committee

The Steering Committee members are identified in Figure 3. As indicated, the Secretary of the Directorate General served as Chairman, and the TSS-IDA Project Manager as Secretary. The chiefs of the operating directorates were members, along with appropriate officials of the Ministry, a representative of the World Bank, and a provincial public works director.

^{1/} The title "director" is used in this report to represent the chief of an operating directorate, such as Construction, Maintenance, or Supplies and Equipment.

Figure 3

STEERING COMMITTEE MEMBERSHIP

A Steering Committee was appointed to guide development of the Bina Marga training program, and to make recommendations on training policies, priorities and program characteristics to the Director General. Individuals occupying the positions identified below served on the Committee.* Their names are shown in parentheses.**

1. Secretary of the Directorate General Bina Marga (Ir. S. Tenkean), Chairman;
2. Project Manager, TSS-IDA (Ir. Z. Abidin Aziz), Secretary;
3. Director, Directorate of Planning (Ir. Surjatin);
4. Director, Directorate of Maintenance (H. M. Hidayat, B.E.);
5. Director, Directorate of Supplies and Equipment (Ir. Sunarno);
6. Director, Directorate of Soils and Road Research (Ir. Mudjitiba);
7. Director, Department of Public Works, Province of West Java (Ir. K. Somawidjaja);
8. Director, Center for Education and Training, Ministry of Public Works and Power (Ir. Sufaat);
9. Chief, Bureau of Personnel, Ministry of Public Works and Power (Ir. S. Tjakradipura); and
10. Chief Engineer, Indonesia Office, International Bank for Reconstruction and Development (Mr. A. van Dijck).***

* Mr. J. F. Chudley, Team Leader, United Nations Development Programme, also participated in all meetings.

** The individuals shown served until 30 August, 1975; the Director General made a few personnel changes on that date.

*** The project was carried out with a loan from the International Development Association. The World Bank administered the loan for IDA.

The Secretary Bina Marga makes most final training decisions, such as those on Training Unit manpower and organization, production schedules, and implementation schedules. The Steering Committee made recommendations on basic training policies, priorities and program characteristics. Through the Steering Committee, with its control over both the Technical Panel and the Central Training Unit, the directors maintained control over work methods, workmanship requirements, and training efforts.

One provincial public works director served on the Steering Committee as a representative of the 26 public works directors. His function was to ensure that the training program would be practical and fully acceptable at the working levels of the provinces.

Coordinating Committee

The Secretary Bina Marga and the Directors serve as a permanent Coordinating Committee for Bina Marga. This Committee meets regularly on matters of concern to Bina Marga as a whole. Upon completion of TSS-IDA, the Steering Committee was dissolved, and the Coordinating Committee took over. Selected Steering Committee functions—training needs analyses and priority recommendations, particularly—were delegated to the Technical Panel, the individual members of which represent the Secretary Bina Marga and the directors.

Technical Panel

As depicted in Figure 2, the Technical Panel is advisory to the Central Training Unit. In actual fact, the members are selected and appointed by the directors, and final decisions are controlled by them.

The functions of the Technical Panel are itemized in Figure 4. To repeat, the operating directorates retain control over methods, workmanship requirements and management systems. Each directorate could, of course, have its own technical panel, but this frequently would result in inconsistencies, and in critical delays for training production specialists.

Figure 4

FUNCTIONS OF THE TECHNICAL PANEL

The Technical Panel is to:

1. identify current maintenance and construction work methods and quality standards;*
2. identify official Bina Marga practices, as represented by manuals and memorandums;*
3. identify standard engineering practices, such as those developed by the American Association of State Highway and Transportation Officials, and the American Society for Testing and Materials;*
4. compare current methods and quality standards with official Bina Marga practices and standard engineering practices—to identify potential improvements for Indonesia;
5. confirm current methods and quality standards, make modifications, or replace them as necessary to provide logical, practical, complete and consistent work methods and workmanship requirements for Bina Marga and the provincial highway agencies; and
6. recommend adoption of final work methods and workmanship requirements by the Bina Marga directorate concerned.

* The first three steps typically are carried out for the Technical Panel by assigned training production specialists or by specially assigned engineers.

The work methods cover a wide variety of operating activities, with those attributable to construction, maintenance and equipment being dealt with first. To limit the Panel to members who can make knowledgeable, technical contributions to the work immediately under way, individuals are added to and dropped from the Panel according to the work methods being developed. Alternatively, additional technical panels can be created.

Central Training Unit

The Central Training Unit carries out the functions listed in Figure 5.^{2/} As can be seen, the Central Training Unit serves the operating directorates of Bina Marga, and through them the counterpart divisions of the provincial public works departments. It designs all training programs from work methods, workmanship requirements and management systems developed by the operating directorates. It produces the courses required, with full responsibility for the training techniques to be used—selecting techniques that will permit the operating directorates to conduct most actual training.

The Training Unit arranges for training to be conducted by special instructors (from outside the operating organizations) when no acceptable alternative exists. This is illustrated by crane operator training, since the supervisors are not crane operators. It is also illustrated by management training, since all managers are participants in the training itself.

The Central Training Unit clears its programs, priorities, policy recommendations, plans and schedules with the Secretary Bina Marga.

^{2/} As a matter of information, the Central Training Unit currently is treated as a "project" within the Bina Marga organization. The Project Manager reports to the Secretary of the Directorate General. Project status is maintained for three reasons: special financing; to ensure that the Training Unit has been well founded, organized and integrated into the Bina Marga organization; and, to complete critical courses now in production.

Figure 5

PRINCIPAL FUNCTIONS OF THE CENTRAL TRAINING UNIT

The Central Training Unit is to:

1. identify training needs and priorities;
2. design training courses based on work methods and workmanship requirements approved by the Technical Panel;
3. produce and test the courses;
4. review draft courses with the Technical Panel to ensure compliance with approved work methods and workmanship;
5. deliver copies of final courses to operating directorates and provinces in the numbers needed for actual training;
6. assist supervisors and provincial training officers in implementing the courses;
7. arrange for special-instructor training through universities and other organizations as needed, and design the training;
8. conduct special courses (workshops and seminars) when this is the only practical approach;
9. develop the training management system—such as policies, procedures, and course production and implementation guides;
10. prepare training production and implementation plans, schedules and budgets; and
11. present Items 1, 7, 8, 9 and 10 to the Secretary of the Directorate General for final approval.

Public Works Directors

Each public works director is accountable to his provincial governor for the operations of his organization. The governors hold their directors responsible for complying with National plans, programs, engineering standards and other requirements for obtaining aid in connection with highway construction and maintenance.

For highway purposes, each director represents the Director General Bina Marga. As such, he is the chief training officer for provincial highway operations, as indeed he is for all other operations under his control.

The public works directors delegate responsibility for managing highway training programs to their provincial training officers, and responsibility for conducting actual training to their chief highway and chief equipment engineers.

Provincial Training Officers

As with the Central Training Unit, the provincial training officers service the operating organizations. They do not themselves conduct training; they administer the programs through operating supervisors. This is in keeping with two of the basic principles: "Employees learn best when trained by their regular supervisors," and "Supervisors support training best when they conduct it themselves." It is necessary as well: their administrative work loads are so extensive that time will not permit them to become instructors.

Operating Supervisors

The final link in the organization is represented by the operating supervisors—in both the Bina Marga directorates and the provincial public works departments. They conduct the training.

Supervisors are expected to use the courses only when they will get better work-performance results, or faster results, than they would some other way. They are accountable for results, not for conducting training for its own sake.

The supervisors are obligated to apply the work methods, workmanship requirements and management methods represented in the courses.

Chapter Two

WORK METHODS DEVELOPMENT

Development of proper work methods, one of four major elements of the training program, is uniquely important in Indonesia. This, plus the need to make sure that good work methods are used, are discussed in the first two sections below. The ways methods are developed and approved are discussed in the third section.

Unique Importance

Bina Marga and provincial public works engineers have limited access to information on standard engineering practices. And, if the work is done properly, benefit-cost relationships will greatly improve.

Access to Information

Highway engineers in Indonesia have almost no access to engineering research results developed elsewhere. Technical books and references, research reports and engineering magazines are extremely difficult to obtain, and the rare ones available are written in English.

The country is large, engineers are few, and work loads are heavy, making it very difficult for highway engineers to exchange information within Indonesia. The first highway engineering association (the usual instruments for advancing the state of the art, presenting formal papers on research findings, and exchanging experience information) has only recently been established.

Technical information obtained by Bina Marga must be translated, reproduced and distributed if it is to be made available to its own engineers and those in the provinces. This, too, is unusually difficult to accomplish; technical translators are scarce, and time rarely is available for regular operating engineers to do the work.

Since sources of technical information are so limited, current work methods and workmanship requirements vary widely, even between crews in the same province.

Benefit-Cost Relationships

Since work methods and workmanship vary so widely, road conditions vary widely as well. So do the costs of getting equivalent work done.

In recognition of these considerations, Bina Marga adopted the policy statements shown in Figure 6. As can be seen, the objective is to standardize the ways work is done—to improve results and reduce costs.

Work Methods Selection

Work methods should be developed for carrying out essential work only. And, according to the policy, the work methods should be "those best suited to Indonesia."

Essential Work

The work loads of many large and complex organizations, having been developed over many years, frequently contain activities that represent nonessential, nonuseful work. This is particularly true in organizations where crew-level supervisors must themselves determine much of what should be done and how it is to be done.

Deficiencies that should exist before work is initiated must be defined. "Asphalt cracks must be as wide as a pencil before being filled," for example. Some crew

Figure 6

WORK METHODS POLICIES ADOPTED BY BINA MARGA

Two policies related to work methods were adopted by Bina Marga:

- One - Work methods used and workmanship required for maintaining, rehabilitating, upgrading and constructing roads and bridges will be those best suited to Indonesia. They will be uniform throughout Indonesia, with only such modifications as are appropriate for rural and urban situations.
- Two - Bina Marga and provincial employees engaged in maintaining, rehabilitating, upgrading and constructing roads and bridges, operating equipment, or servicing and repairing equipment shall be trained to use work methods and to apply workmanship standards adopted for Indonesia.

* For complete copies of the policies, see Policy Statements 2 and 3, starting on page A-3 in the Appendix.

foremen will otherwise repair asphalt cracks that need not be repaired, or regravel roads that have fully acceptable crowns and crusts.

Best Suited

Bina Marga defined the procedures for developing work methods in the policy itself.^{3/}

An excerpt from that policy, paraphrased below, shows that standard engineering practices are to be used as guides:

Bina Marga is responsible for developing work methods and establishing workmanship standards. Development personnel will take full advantage of practices in other countries, and of standard engineering practices developed elsewhere.

In many cases, standard engineering practices are adopted without change. In many others, the changes are minor, no more than necessary to recognize equipment limitations in Indonesia, or local materials availability.

Development Procedures

The procedures for developing work methods and for getting them approved have also been defined.

^{3/} For the total implementation statement, see the policy statement previously cited, starting on page A-3 in the Appendix.

Development

A guide to developing methods and workmanship standards is included in the policy statement:

Observations will be made of work being performed by Bina Marga and provincial forces to identify problems unique to Indonesia, and solutions developed by Indonesians. Alternative improvements will be explored and tested as necessary.

A wide variety of technical references has been used in developing work methods. The first source has been the technical reference library of Bina Marga.^{4/} This has been supplemented by publications from the American Association of State Highway and Transportation Officials, the American Society for Testing and Materials, the Asphalt Institute, and similar organizations in France, England, Australia and other countries. Training courses available from other highway agencies have been particularly useful.

Special research has been directed toward finding ways to get acceptable results from unique local materials, such as butas (a natural asphalt).

Approval

As indicated in Chapter One, all work methods are approved by the Technical Panel. By policy, the Technical Panel submits them to the appropriate director for final approval. If there is any question at that point, the director clears it with the Coordinating Committee.

Work methods have been defined in two forms: as course designs or as road notes. Course designs have been used whenever standard practices elsewhere have been adopted with no more than minor changes. Road notes (recommended engineering practices) have

^{4/} Under a previous contract, Kampsax-Berger prepared a large number of work methods.

been prepared whenever it has been necessary to create original work methods, or make radical changes in practices followed elsewhere.^{5/}

^{5/} Example course designs are included in the Appendix, starting on page A-14. An example road note is included, starting on page A-21.

Chapter Three

TRAINING COURSE PRODUCTION

Once work methods and workmanship requirements have been defined, training courses and series of courses can be produced. Production, the second of four major program elements, involves course design, technique selection, draft preparation, master preparation, and reproduction. Training guides are prepared as the final step.

Course Design

Training production is a continuous, often overlapping process from methods development to completion of the master copy. (This explains why course design had to be discussed to some extent as a part of work methods development in Chapter Two.)

A standard course design contains six parts:

1. a statement of the course objective;
2. the employee categories to be trained with the courses;
3. the training techniques to be used;
4. a statement of the subject matter to be covered;
5. cross references to other courses in the series; and
6. potential sources of additional subject matter information.

Course Objective

The way the Central Training Unit typically defines a course objective is shown in Figure 7.

In each case, the objective:

1. describes the capabilities trainees are to have upon completion of the course;
2. summarizes the contents of the course; and
3. places outside limits on the course—to avoid unnecessary duplications from one course to the next.

Trainee Identification

Bina Marga identifies trainees by employment category, as distinguished from personnel classification titles. The ways work and crews are organized vary from province to province, making training by personnel classification impossible.

Each employment category has previously been identified in terms of such training-related characteristics as reading and calculating capabilities.

Training Techniques

The six principal training techniques used by Bina Marga are identified in Figure 8.

The first four techniques—diagrams, workbooks, audio-visual courses and demonstrations—are designed so that the training can always be conducted by regular

Figure 7

PARTS OF A TYPICAL COURSE DESIGN
(Exclusive of Course Content)

COURSE TITLE: Excavation and Embankment Supervision.

COURSE OBJECTIVE: Each trainee must be able to supervise all activities connected with excavating road sections and constructing embankments, including:

1. preconstruction preparation;
2. construction methods and quality standards;
3. correct selection and use of materials; and
4. proper staking for alignment, right-of-way limits, and elevations.

He must know the criteria for final inspection and acceptance of the work. Training in surveying, sampling, testing, and work management will be excluded from this course.

TRAINEES: Recent graduate engineers and advanced engineering technicians.

TRAINING TECHNIQUE: Workbook.

PREREQUISITE COURSES: Classification of soils and aggregates; basic characteristics of roads.

COURSES IN SERIES: Hydraulics of drainage and pipes; drainage; pipe culvert placement; and, borrow operations.

TECHNICAL REFERENCES: The North Dakota course on excavation and embankment inspection contains much useful material. It cannot be used directly because of the change in personnel involved.

Figure 8

PRINCIPAL TRAINING TECHNIQUES*

SELF-INSTRUCTIONAL TECHNIQUES:

Diagram—used when a single large chart or a series of such charts can be posted for continuous reference. The actual training may be done from the diagrams, or may require other techniques, leaving the diagrams for reference purposes.

Workbook—used when the work method itself requires reading and writing, or when the trainees need a personal reference manual following training.

Audio-Visual—used when the work method is manual or skilled, such as sampling and testing, and when colored photographs are essential to making points.

NONSELF-INSTRUCTIONAL TECHNIQUES:

Demonstration—used with diagrams, workbooks and audio-visual courses to show how the work is done, and to give participants practice in doing it.

Workshop—used when the training is organized around a graduated series of demonstrations and practice sessions, in which practice sessions are the dominant form of training. Equipment operators and surveyors are typical workshop trainees.

Seminar—used for middle- and advanced-management training, where the participants cannot be expected (for lack of necessary time) to carry out work-related exercises.

* Additional techniques and combinations of techniques are used, such as films, case problems, and classroom sessions. The large majority of courses are represented by the techniques defined above.

operating supervisors. Some of the workshop courses can be conducted by regular supervisors as well, such as those for equipment servicing and repairs.^{6/}

Advanced workshop courses and seminars are conducted by special instructors. Since these techniques are in conflict with two basic training principles (employees learn best when trained by their regular supervisors, and supervisors support training best when they conduct it themselves), Bina Marga resorts to them only when the others cannot be applied. Engineers and advanced technicians cannot be expected to train equipment operators, as an example. And management training requires instructors with extensive management experience backgrounds, plus unique training capabilities.

As indicated in Figure 8, some courses are self-instructional, others are not. The self-instructional courses permit individuals and small groups to complete most of the training themselves, subject only to follow-up discussions with supervisors as needed for local considerations.

Prerequisite Courses

A second limitation on course content is represented by courses that must be taken in advance of the one to be prepared, as indicated by prerequisite courses in Figure 7. The production specialist must review each such course, identify any terminal sections of those courses that should be included in the new one for refresher or connecting purposes, and avoid all other duplications.

^{6/} The term "equipment workshop" is used in Indonesia to represent "shops for servicing and repairing vehicles and other highway equipment." The term "workshop" is used in this report to identify a training technique—any training that involves presentations, demonstrations and practice sessions. Since no other term communicates as well as "workshop" for the training function, and "equipment shop" is as good a term as "equipment workshop" in referring to an equipment service and repair facility, "workshop" has been reserved exclusively as a training term.

Courses in Series

Courses are designed in series to ensure against duplication.

Bina Marga limits the subject matter of most courses to single work assignments. Since work loads vary widely among the provincial public works departments, individual duties and responsibilities vary widely as well. By limiting each course, most employees can take training they need without taking courses they do not need. Also, various combinations of courses can be put together for training complete crews, such as asphalt resurfacing crews ^{OR} ~~OR~~ excavation and embankment crews.

Course Content

The course content section has been omitted from Figure 8, since each one runs to several pages—sometimes upwards of 50.

Content statements vary from one course design to the next. They range from detailed itemizations of the points to be covered to fully defined work methods and workmanship requirements. When coverage is itemized but work methods are omitted, the methods are fully defined in the drafts—and the drafts are reviewed by the Technical Panel.

Course Preparation

A separate technical manual has been prepared on course production, making it necessary to cover only a few points in this report: on-site data collection; other-source data collection; and instructor-supervisor considerations.^{7/}

^{7/} Course Production Manual, Central Training Unit, Bina Marga, 1975. A copy can be obtained by any highway agency on request.

On-Site Data Collection

The adopted work methods must be shown in any photographic presentations. Since these methods are new, they must be demonstrated (posed) for course production purposes—to be photographed.

Bina Marga arranged with selected provincial public works departments to provide crews, equipment, materials and work sites for photographic work. The work is done in accordance with approved methods and workmanship requirements. The crews are supervised by the production specialists involved—creating precisely the situations needed for photographs, including errors to be avoided and corrective actions to be taken.

Other-Source Data Collection

Photographs and graphics are taken from courses produced elsewhere to the extent that they can be used in Indonesia.

Original graphics are prepared when on-site photographs are inadequate, and when available graphics will not do. (Graphics that are almost, but not quite, perfect will not do, since too many trainees will miss the points being made.)

All wall diagrams have been prepared as originals by the Central Training Unit. Equipment manuals provided by manufacturers and the equipment units themselves have been used as sources.

An extensive library of texts, manuals, films and other references has also been collected by the Central Training Unit.

Instructor-Supervisor Considerations

In order that regular operating supervisors can serve as instructors for their own employee groups, the Central Training Unit prepares an instructor's guide for each course.

The guide includes:

1. the course design statement, or an abbreviation of it;
2. a discussion guide—questions typically asked by participants and suggested responses;
3. supplemental exercises for participants who have difficulty with some sections of workbooks;
4. the reasons for unique changes in longstanding work methods or quality standards; and,
5. suggestions on how best to conduct the training—such as the number of participants in each session, and proper timing of discussion sessions.

Courses to be followed by demonstrations require full descriptions of the demonstrations in the guides.

Finally, supervisors are advised that few courses are complete in themselves. Some items are deliberately omitted from the courses but included in the guides—to ensure that instructor-supervisors can be fully effective in training their employees. Prevalent work methods errors are particularly good for this purpose. And all local considerations, such as soils conditions, must be covered by the instructor-supervisors.

Course Completion

Once a course has been drafted and approved by the Technical Panel, a master must be prepared, and the course must be reproduced.

Master Preparation

Any technical errors identified by the Technical Panel are corrected as part of the drafting work. Final graphics are then prepared, since it is too expensive to use more than sketches for Panel reviews. If the course is prepared in English, it must be translated into Bahasa Indonesia for the master copy.

Original cassette tapes, usually "voiced" by professionals in other countries, are voiced by selected Bina Marga employees.

Reproduction

Bina Marga prints its own wall diagrams, workbooks and instructor's guides, and reproduces its own cassette tapes. Slides are reproduced by commercial firms.

Chapter Four

PROGRAM IMPLEMENTATION

Implementation is the third major element of the Bina Marga training program. As indicated in Chapter One, operating supervisors conduct most of the training. Implementation specialists provide any necessary guidance.

Operating Supervisors

The operating directorates of Bina Marga form one set of organization structures through which the program is implemented; the 26 provincial public works departments represent another.

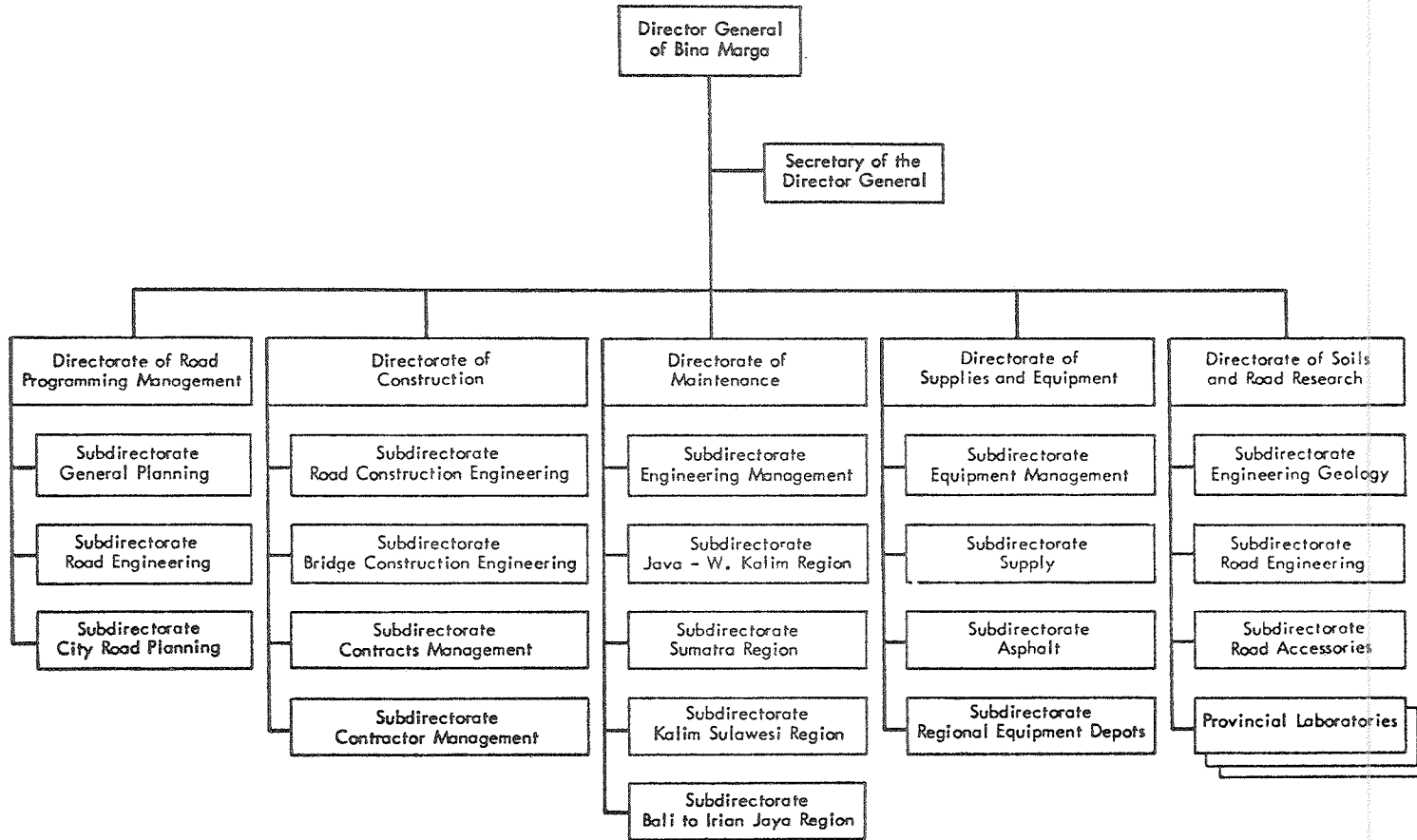
Bina Marga

Bina Marga operations are carried out through five directorates. The training program thus far has been concerned with only three: Construction, Maintenance, and Supplies and Equipment. Within these three, it has involved nine subdirectorates: Road Construction Engineering, Bridge Construction Engineering, Equipment Management, Regional Equipment Depots, and the five shown under Maintenance in Figure 9.

Each director is the chief training officer of his directorate, responsible to the Director General for implementing the training program. The chief of each subdirectorate in turn is responsible for conducting the training, or ensuring that regular supervisors in his organization conduct it.

Figure 9

ORGANIZATION OF BINA MARGA



Provincial Agencies

Each of the 26 provincial public works departments is organized in a different way. All are responsible for public works: highways and bridges; buildings; and irrigation. A typical organization structure is depicted in Figure 10.

In the case shown in Figure 10, the highway division has established sections for carrying out road works only. In others, the sections or districts are responsible for roads plus other, and sometimes all, public works functions.

Regardless of how a public works department is organized, the director is the chief training officer. He is assisted by a provincial training officer, located in the Administration Division in most provinces, but in the Highway Division in a few. The actual training is carried out by the highway chief, equipment shop supervisor and section engineers.

As a matter of information, the numbers of sections in a single province range from 3 to 35, with the average being 9.

Implementation Personnel

Provincial training officers administer the training programs for their public works directors; they do not serve as instructors. They are guided and assisted by Central Training Unit implementation officers.

Provincial Training Officers

The principal duties and responsibilities of the provincial training officers are summarized in Figure 11.^{8/}

^{8/} A complete position description is included in the Appendix, starting on page A-25.

Figure 10
TYPICAL ORGANIZATION STRUCTURE
PROVINCIAL PUBLIC WORKS DEPARTMENT

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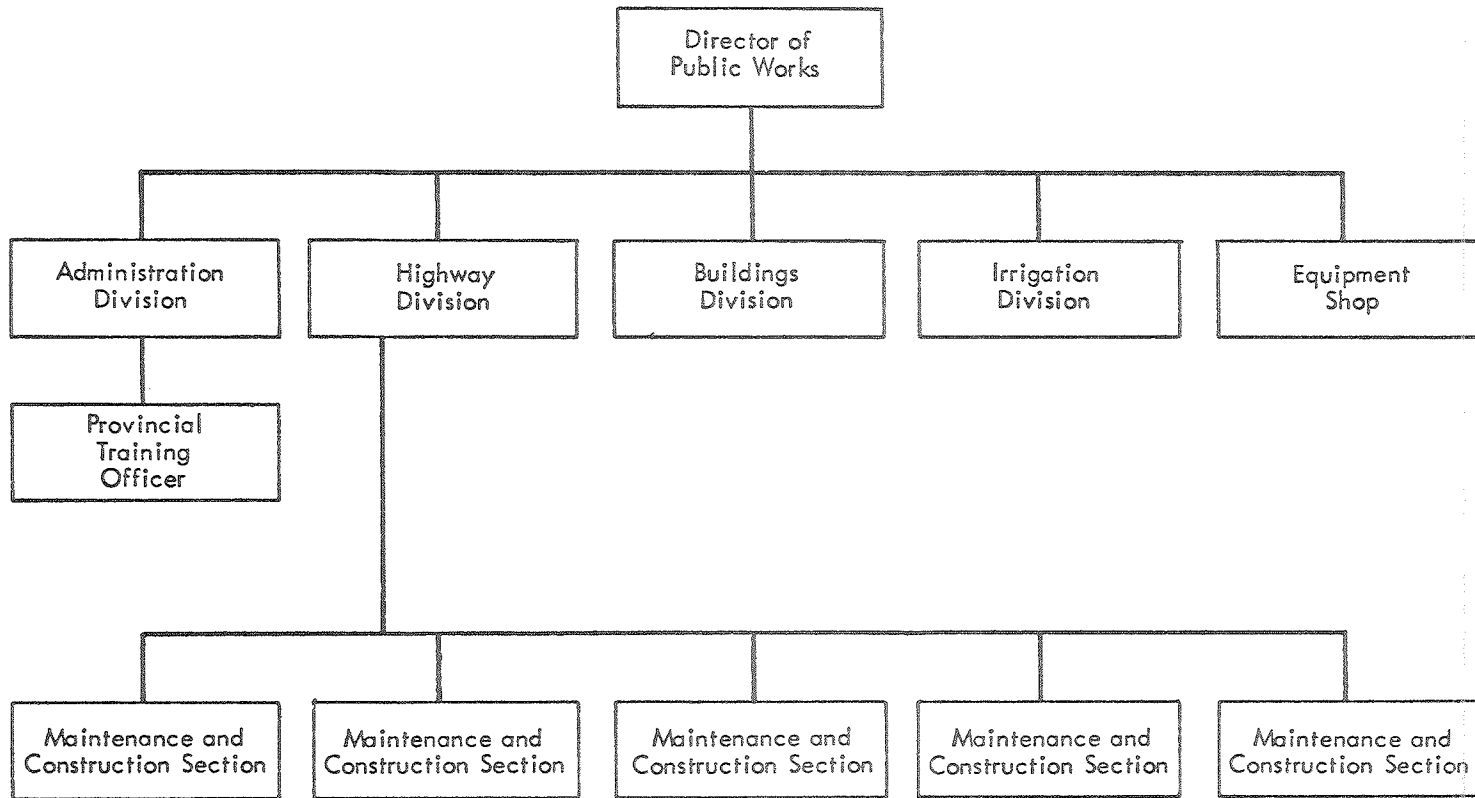


Figure 11

PRINCIPAL RESPONSIBILITIES OF PROVINCIAL TRAINING OFFICERS

Provincial training officers:

1. maintain manpower inventories—names of all employees together with personnel classifications, organization units, employment locations, age, education, experience and other training-related data;
2. obtain estimates of future manpower needs by organization unit and employment category;
3. maintain the Public Works Training Library;
4. plan and schedule training for maximum utilization of courses and equipment, in accordance with priorities;
5. guide and assist regular operating supervisors in training their employee forces;
6. evaluate administrative characteristics of the courses, and obtain supervisory evaluations of work-performance results;
7. coordinate with the Central Training Unit on special training needs and programs;
8. keep operating supervisors and public works directors informed of training needs and training completions;
9. make reports to the Central Training Unit as required for improvements in and management of the program; and
10. prepare provincial-level training budgets, and control costs to approved budgets.

It will be noted that these individuals serve as unofficial extensions of the Central Training Unit as well as official assistants to their directors. They plan, schedule, and monitor the conduct of training, providing assistance to the instructor-supervisors as needed. The officers meet with Central Training Unit implementation officers to learn all they can about each course and series of courses, and pass the information on to the supervisors. Since they work with all the supervisors, the training officers also pick up and pass on implementation experience within their provinces.

Central Implementation Officers

As with the training officers in the provinces, implementation officers in the Central Training Unit have no instructor functions, except to the extent that they develop the provincial training officers.^{9/} They demonstrate implementation techniques, clarify points, observe implementation under way and counsel training officers on improvements. Since they travel from province to province, they are able to pick up effective techniques and pass them on.

Thus far in the project, the Central Training Unit implementation officers have concentrated on programs in the provinces. As the provincial training officers become increasingly independent, concentration will shift to the operating directorates of Bina Marga.

^{9/} A complete position description is included in the Appendix, starting on page A-25.

Chapter Five

TRAINING MANAGEMENT SYSTEM

The training management system, the fourth major element of the training program, consists of the organization for training, functional statements and position descriptions as discussed in Chapter One. It also consists of an information system.

The information system is based on requirements—who must have what information in order to take proper actions? The first six sections of this chapter deal with information requirements:

1. program objectives;
2. policies governing the program;
3. manpower needs;
4. training needs and priorities;
5. production and implementation schedules, and progress reports; and
6. training evaluation reports.

The final section deals with the training management manual.

Objectives

All persons involved in the program must know its objectives. There are two:

1. to develop knowledge and capabilities as needed for highway operations at the national and provincial levels—except those provided by educational

institutions; and

2. to ensure uniform, nationwide application of work methods and work standards adopted by Bina Marga.

Knowledge and Capabilities

The first objective applies to all levels of personnel in Bina Marga and the provincial highway agencies. It covers all combinations of knowledge and capability unique to highway operations, as distinct from those mastered in schools, colleges, and universities.

The objective is to ensure that the personnel can carry out their work assignments properly. If they cannot, they need training—or should be replaced by others who can do the work.

Uniform Work Methods

The second objective supports the first. The directorates of Bina Marga will define work methods and workmanship standards. The training program will be designed to ensure understanding of those methods and standards, and ability to apply them.

Policies and Procedures

All persons involved in the program must also know the framework of policies within which the program will be carried out, and who is responsible for implementing each policy. The Steering Committee recommended adoption of eight policy statements; all were approved by the Director General. They are summarized below.^{10/}

^{10/} The eight policy statements are included in the Appendix, starting on page A-1.

Policies Preparation

In summary, the first policy statement provides that:

- all training policies having general application to officials involved in the program will be set forth in a series of statements; and
- the statements will be prepared by the Central Training Unit, recommended by the Coordinating Committee, approved by the Director General, and made available to all concerned.

Work Methods

The second statement, as indicated in Chapter Two, provides for work methods development:

- work methods and workmanship will be uniform throughout Indonesia; and
- Bina Marga (actually the operating directorates of Bina Marga) is responsible for developing the methods and workmanship standards.

Course Production

The third statement provides that:

- Bina Marga and provincial highway employees will be trained relative to the official work methods and standards; and
- the Central Training Unit will produce the courses.

Management Improvements

The fourth policy recognizes the need to control results and costs through management improvements. It states that:

- productivity rates will be improved and unit costs will be reduced through, among other things, effective management of work loads, manpower and equipment;
- Bina Marga (the operating directorates) will develop management methods and guidelines; and
- the Central Training Unit will produce appropriate courses.

Training Implementation

The fifth statement covers implementation of the training:

- the regular operating officials of Bina Marga will implement the training program within Bina Marga;
- the regular operating officials of the provincial public works departments will implement the program for their highway employees; and
- Bina Marga (Central Training Unit) will supply the training materials at no cost to the provinces.

Training Evaluation

So the training program can continuously be improved, the sixth policy statement provides that:

- the training program and courses will be evaluated in terms of ease of administration and results obtained at work sites;

- implementation officers will evaluate administrative aspects of the program, and operating officials will evaluate work-site results; and
- the Central Training Unit will improve the programs and courses in response to evaluation findings.

Technical Reference System

Since the training program will never be able to cover all technology needed for the program, the seventh policy provides that:

- a technical reference library will be established and maintained in Bina Marga and each provincial department of public works;
- the Central Training Unit will develop and manage the Bina Marga library, and provide for its duplication in the provinces; and
- provincial training officers will manage the provincial libraries.

Program Availability

The final policy statement makes the program available to all who can use it. It states that:

- highway employees shall always be trained first; and
- courses and other materials can be made available to other public work agencies (national, provincial and local), and to consultants and contractors engaged in highway work, to the extent that they will be useful.

Manpower Needs

The Central Training Unit and the Coordinating Committee must know how many employees must be trained in order to plan and schedule training programs.

Under normal circumstances, the information is supplied by operating officials. In this case, the project staff developed manpower needs estimates.

Estimating Techniques

Manpower needs estimates were developed within a general framework of performance budgeting. The procedure used in developing estimates for routine and periodic road maintenance activities is summarized in Figure 12.^{11/}

The technique, as can be seen in Figure 12, is to estimate the annual work loads and, using proper crew sizes and reasonable productivity rates, compute the manpower required to accomplish them. Similar techniques were used in estimating manpower required for bridge construction, and equipment service shop activities.

Needs Estimates

The 1979 manpower needs for maintenance, upgrading and construction work loads (as represented by Repelita II) are estimated in Figure 13. The estimates include those for Bina Marga and the provincial highway agencies, consultant design firms and construction contractors.^{12/}

11/ The manpower needs report includes complete procedural descriptions, plus year-by-year estimates through 1979. It has been given to Bina Marga and the International Bank for Reconstruction and Development.

12/ Without being able to identify upgrading and construction projects that will be carried out by government and by contractor forces, only total estimates could be used.

Figure 12

SUMMARY OF PROCEDURE USED IN ESTIMATING MANPOWER NEEDS
FOR ROUTINE AND PERIODIC MAINTENANCE

1. The roads were classified according to type of maintenance work involved—earth, gravel, low-type asphalt, intermediate asphalt, and high-traffic asphalt;
2. The kilometers of road in each such classification to be maintained in each province were counted;
3. Key routine and periodic maintenance activities were defined—those representing about 80 percent of the work;
4. The frequency with which each activity should be carried out (to provide proper service to road users) was identified;
5. Standard crew sizes and equipment complements, average materials requirements, and reasonable productivity rates were determined for each key activity;
6. The values obtained in Steps 2, 4 and 5 were used to calculate annual manpower needs for each key activity in each province;
7. The values obtained in Step 6 were increased by 20 percent to allow for nonkey activities; and
8. The total crew-day requirements were analyzed to estimate manpower needs by employee category.

Figure 13

ESTIMATED MANPOWER NEEDS

Estimates of manpower needs for 1979 are shown below. All estimates must be considered provisional, subject to major changes as characteristics of the highway program and management systems are worked out.

		1979 Estimated Needs	Current Employment
Engineers:			
● Management	1,035		
● Project*	255		
● Laboratory	100		
● Equipment	<u>155</u>		
		1,545	900
Engineering Technicians:			
● Advanced construction	770		
● Subordinate construction	3,910		
● Advanced laboratory	300		
● Subordinate laboratory	1,800		
● Surveyors (transitmen)	<u>900</u>		
		7,680	3,600
Field Supervisors, Laborers:**			
● Superintendents	2,215		
● Labor foremen	7,350		
● Skilled laborers	<u>11,030</u>		
		20,595	4,400
Equipment Operators:			
● Truck drivers	7,300		
● Roller operators	1,800		
● Loader operators	270		
● Distributor operators	290		
● Dozer operators	210		
● Motorgrader operators	570		
● Stone crusher operators	<u>140</u>		
		10,580	2,800
Equipment Workshop Personnel:			
● Supervisors	210		
● Mechanics	675		
● Craftsmen	235		
● Service personnel	<u>1,710</u>		
		2,830	1,200
Total		<u>43,230</u>	<u>12,900</u>

* Project engineers and advanced engineering technicians will have to substitute for each other to make up for any shortages.

** Excluding common laborers.

The needs estimates in Figure 13 include those for engineers, laboratory technicians and surveyors—three groups that thus far have been exempt from work methods training efforts. The targets have been the other categories shown in Figure 13—about 38,700 persons. Approximately 10,800 of those currently employed represented immediate target groups.

Training Needs and Priorities

The Central Training Unit must also know what the training needs are, and their priorities.

To repeat, the work methods and workmanship requirements represent training needs for most employment categories. Management methods and engineering practices represent training needs for the rest.

Needs

The activities to be performed were identified and classified as training needs. A tentative course title, with a brief description of subject matter coverage, was used to name each need.

The titles and coverage descriptions were changed as course designs were prepared. For one thing, the subject matter often expanded greatly as work methods were fully defined. For another, it seemed best to avoid producing courses that would be too long for the trainees and instructor-engineers. Also, individual training requirements vary widely due to variations in work loads and, consequently, in the ways crews are assigned to handle them. If too many work methods were included in any course, too many trainees would be taking training they cannot use.

Priorities

The Secretary Bina Marga, guided by the directors, sets priorities for course production. The initial priorities having been filled, the Secretary obtains priority information from the provincial public works directors, and by analyzing upcoming programs.

The initial priorities were based on the manpower and training needs data, plus these considerations:

- Road maintenance levels had to be improved quickly, and 32,000 kilometers of roads, together with bridges, must be maintained annually;
- Equipment fleets had to be serviced properly, to avoid expensive repairs; and
- Several large work loads must be completed before 1979, including:
 - + 1,500 kilometers of new highways,
 - + 12,500 kilometers of betterment projects,
 - + 6,000 kilometers of rehabilitation projects, and
 - + 30,000 meters of new bridges and bridge repairs.

Schedules and Progress Reports

Bina Marga directors need to know planned completion dates for courses in process. They and public works directors need implementation schedules and progress reports.

Production Schedules, Reports

It takes about three man-months to complete an average course from design through the premaster stage. Since there are many delays in the process, each production specialist needs three or more courses under way to maintain his productivity rate.

training guides (see also manuals): 177, 181-183, 200, 211, 213-222, Ref. 4, Ref. 7, Ref. 8, Ref. 10

training management, see training programs

training needs: 26, 95, 119, 127-128, 151, 155, 159, Ref. 9
study, xxvi-xxvii, xxviii, 21, 135-155, 160, 161-169, 194-195, Ref. 5, Ref. 6, Ref. 9

training production units: xii, xiii, 40-41, 52, 64, 87, Ref. 2

training programs: xv-xvi, xx, xxv, xxviii, 11-12, 39-46, 159-186, 225-227, Ref. 1, Ref. 2
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schedules, 128-130, 159, 198-200, Ref. 7

training research: 67-80, Ref. 3

training staff, see trainers

training techniques (see also training aids; training programs): 105-108, Ref. 3, Ref. 5

Transport and Road Research Laboratory (Old Wokingham Road, Crowthorne, Berkshire RG11 6AU, U.K.): Ref. 1, Ref. 2

Transportation Research Board (2101 Constitution Avenue, N.W., Washington, DC 20418) (see also Highway Research Board): Ref. 10

truckers: 226, 229, 231

unions, employee: 198

U.S. Department of Transportation, Federal Highway Administration (400 Seventh Street, S.W., Washington, DC 20590): Ref. 11, Ref. 15

University Microfilms International (300 North Zeeb Road, Ann Arbor, Michigan 48106): Ref. 5

upgrading: 52, 100, Ref. 4

vocational education systems: 20, 69

vocational training: 20, 69

wall diagrams (see also diagrams): 72, 73, 110, 112

winter maintenance: xxxi, 167, 190, 225, 226, 232-233, Ref. 9

Wonderlic personnel test: 148-150

work methods, see training programs

workbooks: 105, 107, 112

workmanship:

evaluation, 163-164

standards, 100, 101, 102

workshops: 107, 108

Zaire: 36, 39-42, 64, Ref. 2

The typical production schedule consists of a bar chart showing:

- the courses, identified by titles;
- the planned period of production for each stage of production;
- the current production status; and
- the planned date of release for implementation.

Training Schedules

Implementation schedules are much more complex than production schedules. Separate schedules are prepared for each employee category, in accordance with priorities set by the public works directors.

So that the courses are used to best advantage, each provincial training officer schedules the use of each course or series of courses. To do this, he must know the name, employment classification, organization unit, location and training needs of each employee. He must ensure that each section engineer, district engineer, and equipment shop supervisor receives the courses he needs at a time when he can use them—and in proper sequence. And he must provide for movements of the courses from section to section.

Training Progress Reports

Each provincial highway engineer and public works director must be informed of progress made in conducting training programs. The Central Training Unit uses summary information for reports to the Secretary Bina Marga and directors. To avoid collecting more information than can be used, reports are made as follows:

- to the provincial training officers—the names of employees trained, training completed, and dates of completion;

- to the provincial highway engineers and public works directors—the numbers of employees needing and completing each type of training, by organization unit;
- to the Central Training Unit—the numbers of employees to be trained and the numbers trained in each province, by employment category and course; and
- to the Secretary and directors—the numbers to be trained and the numbers trained nationwide, by employee category and course series.

Training Evaluation Reports

The Central Training Unit must know whether or not the courses work. If not, something has to be done, such as:

- providing additional guidance to provincial training officers or instructor-supervisors;
- improving the instructor's guides; or
- improving the courses.

Again, to avoid collecting more information than will be useful, the reporting system has been limited. Four provinces evaluate and report on the administrative characteristics of the courses, and on effectiveness of the courses in improving work methods and workmanship. Only two section engineers within each of these provinces make evaluations. This system assumes that, if the courses work properly in these sections, they will work in all sections and all provinces. If any other province has difficulty with them, they are expected to submit special reports. Additional assistance will then be provided or the effectiveness of the courses will be reevaluated.

Training Management Manual

The training management manual defines the program objectives and training organization. It includes copies of the policy statements and position descriptions. Finally, it includes the management information requirements, reporting procedures, and guidelines to key aspects of managing the program.



Project Correspondent Edmilson T. Lemos, Director do Instituto de Pesquisas Rodviárias, DNER, Brazil (photo courtesy of International Road Federation, Washington, D.C.)

HIGHWAY RESEARCH RECORD

Number 241

Maintenance
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Methods Employed in Conducting a Training Needs Study in a Maintenance Division of a State Highway Department

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Valid measures of training needs are made for current and potential maintenance supervisors. They reveal the most urgent needs and the best course content and form for training.

Maintenance subject matter experts and experts in study techniques work as a team to accomplish the following:

1. Ascertain the status of the total supervisory force on factors that affect learning, using employer records to find age, education, experience, and geographic distribution factors.
2. Break down the tasks of each maintenance job and list them in job element statements, to reveal the knowledge, skills, and abilities needed to do the job, which are then combined into KSA statements.
3. Measure how well a random sample of supervisors possesses the knowledge, skills, and abilities needed in their jobs; KSA-based written tests, performance tests, and supervisory appraisals are used and results are projected statewide to find the total number needing training on that KSA.
4. Measure the sample supervisors for their capacity to learn, using a standard test, and using questionnaires and interviews to see if they are willing and have time to take training.

THE objective of this paper is to present a technique that can be used to identify the training needs of highway maintenance supervisors and to develop a plan for training those supervisors.

Three subordinate objectives are involved—

1. To identify the training needs of the maintenance supervisors,
2. To identify the characteristics of the maintenance supervisors that will have bearing on their training, and
3. To use the training needs data and the supervisor characteristics data, together with current training technology, in developing the plan for training maintenance supervisors.

TRAINING NEEDS IDENTIFICATION PROCEDURE

Identification of the training needs of maintenance supervisors involves four steps: (a) development of a survey organization, (b) identification of the work performed by the maintenance supervisors, (c) identification of the knowledge, skills, and abilities (KSA) needed to perform the work, and (d) identification of the extent to which current supervisors and potential future supervisors have the knowledge, skills, and abilities needed to perform the work. Any lack of required KSA constitutes a training need.

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Survey Organization

The organization required to conduct a training needs survey includes a training needs committee and a project staff.

Training Needs Committee—Persons thoroughly knowledgeable about the specific activities performed by maintenance supervisors are needed for service on a training needs committee. The committee members, as a group, are responsible for defining the work performed by maintenance supervisors, and the knowledge, skills, and abilities needed for satisfactory work performance. They are further responsible for developing tests and other measures used to identify the extent to which individuals actually possess the required KSA.

Project Staff—Two persons are needed on the project staff; both should have specialized knowledge about training. They are responsible for conducting the committee meetings, for collecting and classifying the work data and the KSA data, and for developing the survey materials. They are also responsible for tabulating and interpreting the results, and for developing a recommended plan for training.

Identification of Work Performed

Persons are employed to perform work. It is necessary, then, to analyze the work itself to identify the knowledge, skills, and abilities needed to do the work. Analysis of the work performed by maintenance supervisors (and by almost any group of employees) involves identification of the major elements of the work and of the specific tasks that make up those elements.

Job Elements—The maintenance of roads and bridges involves, among other things, the repairing of subbases and bases, asphalt surfaces, concrete pavements, and structures. Each of these activities can be considered a job element—a definable segment of the work performed.

Job Element Tasks—A task, as the term is used herein, is a unit of work performed in connection with a job element. For example, among the tasks performed in connection with base and subbase repair are (a) the location of the repair work to be made, (b) identification of the materials involved, and (c) calculation of the quantities of materials needed. All significant tasks performed in connection with each job element are identified so that the KSA needed for their performance can be determined.

Job Element Statements—A typical job element statement, that for base and subbase repair, is as follows:

Department of Highways
Maintenance

Job Element Statement
Number 2

BASE AND SUBBASE REPAIR

Scope

The repairing of base and subbase structures.

Tasks

1. Identify the location of needed repairs and the extent of each need.
2. Identify the type of base involved: soil cement, iron ore, concrete pavement, soil, lime treated soil, or sand, clay, gravel.
3. Calculate the quantities of materials required.
4. Locate the source of materials.
5. Plan and initiate the operation:
 - Organize manpower and equipment,
 - Make individual work assignments,
 - Load materials,
 - Proceed to work site.

6. Supervise the performance of work at the job site:
 - Remove the defective base section,
 - Replace the removed material,
 - Compact the material,
 - Shape up the base,
 - Clean up the work site.
7. Prepare records of materials, equipment, and manpower used.

A job element statement reflects a major activity that can be isolated from all other work activities for analysis purposes. The tasks listed are set forth only in such detail as is necessary to indicate the knowledge, skills, and abilities needed for their performance.

Job Element Series—A typical list of job element statements, developed to identify the work performed by maintenance supervisors, is as follows:

1. Asphalt surface repair
2. Base and subbase repair
3. Bridge painting
4. Bridge repair
5. Concrete pavement repair
6. Concrete structures repair
7. Ditch cleaning and shaping
8. Drainage equipment maintenance
9. Equipment maintenance—field
10. Equipment maintenance—shop
11. Fence installation and maintenance
12. Gravel road conditioning
13. Guardrail installation and maintenance
14. Mudjack operation
15. Park maintenance
16. Pavement marking
17. Pipe placement
18. Rest area construction
19. Right-of-way clean-up
20. Roadside mowing
21. Roadside forestry
22. Shoulder and slope maintenance
23. Sign fabrication
24. Sign placement
25. Snow and ice control

Identification of KSA's Required

Each task requires the possession of knowledge and ability for its performance, and some tasks require skill—a term used in this paper to mean unusual ability with tools or equipment. So that these knowledge, skill, and ability requirements can be treated meaningfully from a training standpoint, they must be identified, defined, and classified.

KSA Identification—To calculate the quantities of materials required to repair a sub-base structure, it is necessary to be able to work with whole and decimal numbers and to know the formulas for volumes. If two or more materials are to be used, it is necessary also to know the types of materials and how they will behave when mixed with each other. Each task in each job element is analyzed in this way.

KSA Definition—Each requirement of knowledge, of skill, and of ability includes everything needed, but is limited to that actually needed, for satisfactory work performance. If the employee must be able to add and subtract whole and decimal numbers

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and to calculate areas and volumes, the defined requirement includes, and is limited to, these abilities.

KSA Classification—As each increment of knowledge, skill, and ability is defined, it is combined with others of its kind and classified so that all can be treated meaningfully in terms of training needs identification and training materials development.

Two types of KSA's are developed. The first represents a combination of knowledge, skills, and abilities used by almost all maintenance supervisors, as illustrated in the typical KSA statement that follows:

Department of Highways
Maintenance

KSA Statement
Number 4

MATHEMATICS

ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION

Knowledge

1. Of the relationships between whole numbers, decimals, fractions, and percents.
2. Of the rules that apply in listing whole, fractional, and decimal numbers in order to add or subtract.
3. Of the rules that apply in the placement of whole, fractional, and decimal numbers before they can be multiplied or divided.

Skill

None

Ability

1. To work with whole, fractional, and decimal numbers in calculating quantities, grades, and elevations for road and bridge maintenance work.
2. To convert fractions to decimals and decimals to fractions.
3. To relate numbers to each other as ratios.

The second represents a combination used only by certain supervisors—in this case, those responsible for making base repairs. A typical KSA statement illustrating this type is as follows:

Department of Highways
Maintenance

KSA Statement
Number 30

BASE REPAIRING

Knowledge

1. Of the functions of the base structure of a road.
2. Of the Department standards and specifications applicable to the construction and reconstruction of base structures.
3. Of what constitutes base failure, what causes base failure, and what indicates base failure.
4. Of the different types of bases used: soil and clay; lime or oil treated soil and clay; soil cement; iron ore, shell, gravel; portland cement; and asphalt.
5. Of the equipment used to make base and subbase repairs, and the capabilities of that equipment: draglines, gradalls, motor graders, rollers, tampers, seaman stabilizers, air compressors and hammers, and pull tractors.
6. Of the methods of operation involved in excavating, moving, and placing of rock, soil aggregates, shell, iron ore, and additives to reconstruct base and subbase sections.
7. Of soil density and compaction requirements.

8. Of the special methods and requirements involved in the placement of earth under and in support of drainage pipes and culverts.
9. Of the need to provide for the proper drainage of base structures.
10. Of the special records and reports applicable to base and subbase repairs.

Skill

1. In the use of the specialized tools and the operation of the specialized equipment involved.

Ability

1. To recognize and evaluate the conditions that indicate subbase and base failures, and the extent of such failures.
2. To plan, organize, and supervise the work involved in making repairs to subbase and base structures.
3. To insure that the materials to be used have been sampled and tested and continue to be suitable.
4. To inspect the methods used and the workmanship to insure compliance with adopted procedures and standards and achievement of the desired result.

KSA Guidelines—Four guidelines are followed in classifying knowledge, skills, and abilities for training needs analysis purposes:

1. Each classification describes a single combination of knowledge, skills, and abilities needed for the performance of work.
2. Each single combination is made as broad as possible, but not so broad as to require a significant number of persons to know and to be able to do things not required for the performance of their assigned work. Example: Certain supervisors need to add, subtract, multiply, and divide. Others need to do this and to calculate areas and volumes. Two KSA's are developed to avoid requiring the first group to take training in area and volume calculation.
3. Each combination overlaps the other KSA combination as little as possible. Example: the ability to add and subtract is not included in each KSA where the ability applies.
4. The total series of KSA combinations contains all of the knowledge, skills, and abilities required for accomplishment of all of the work, regardless of the numbers of persons, levels of authority, or numbers of organization units involved.

KSA Series—A typical list of KSA statement titles applicable to maintenance supervisors is as follows:

<u>KSA Statement Title</u>	<u>KSA Number</u>
<u>Basic Group</u>	
Department, division, and district orientation	1
Maintenance function orientation	2
Terms appropriate to maintenance	3
Mathematics—Addition, subtraction, multiplication, and division	4
Equipment—Functions and capacities	5
Equipment—Service	6
Soil and aggregate mixes	7
Portland cement concrete mixes	8
Asphaltic materials	9
Road and bridge maintenance standards	10
Record keeping and reporting	11
Manuals of reference	12
Public relations	13
Communications	14

<u>KSA Statement Title (continued)</u>	<u>KSA Number</u>
<u>Basic Group</u>	
Training—On-the-job	15
Supervision	16
Painting wood, metal, and concrete	17
Inspection of roads and bridges	18
Right-of-way clean-up	19
Snow and ice control	20
Emergency and disaster work	21
Traffic safety activities	22
Utility company contact work	23
<u>Specialized Group</u>	
Contract plan interpretation	24
Blueprint interpretation	25
Mathematics—Areas and volumes appropriate to maintenance work	26
Basic survey (rod and chain work)	27
Intermediate surveying (elevation and alignment work)	28
Excavating and embanking	29
Base repairing	30
Gravel road repairing	31
Asphalt surface patching	32
Asphalt surface leveling and sealing	33
Portland cement concrete repairing	34
Mudjacking	35
Drainage equipment repairing	36
Pipe placing	37
Small concrete structure repairing	38
Roadside mowing	39
Roadside forestry work	40
Guardrail and fence maintenance	41
Bridge repairing	42
Bridge painting	43
Sign painting	44
Sign placement	45
Center and edge-line painting	46
Signal and light maintenance	47
Equipment maintenance—field	48
Equipment maintenance—shop	49
<u>Advanced Group</u>	
First level management	50

No one person needs to know and be able to do all that is represented by the 50 KSA's. Individuals need only to know those things required by their own work assignments. Still, at least one person must know and be able to do all that is represented in each KSA, since each KSA reflects part of the total body of knowledge, skills, and abilities needed to supervise the maintenance of roads and bridges.

The information in the above list indicates that (a) the knowledge, skills, and abilities needed by maintenance supervisors can be classified for training purposes, (b) the various combinations range from initial orientation to the application of management principles and practices, and (c) the majority of combinations reflect the technical aspects of road and bridge maintenance work.

KSA Groups—The 50 KSA statements listed above are placed in three groups: the basic KSA's, the specialized KSA's and the advanced KSA's. The basic KSA group includes 23 KSA's. All maintenance supervisors need to know and to be able to do that which is represented by these 23 KSA's. The specialized KSA group includes 26 KSA's. Individual supervisors need to know and to be able to do only those things set forth in the KSA's that apply to their current work assignments or will apply to their upcoming assignments. One KSA, that for first level management, has been placed in the advanced KSA group. Only persons responsible for planning, organizing, scheduling, directing, and controlling work on a district-wide basis are expected to know and to be able to do those things represented by this KSA. (The advanced group typically contains two additional KSA's, those representing the knowledge, skills, and abilities needed at the middle management and top management levels of the maintenance function.)

Identification of Training Needs

The maintenance supervisors, as a group, must possess the knowledge, skills, and abilities represented by the 50 KSA statements. All supervisors must know and be able to do that which is represented by the 23 basic KSA's. Individual supervisors must know and be able to do that which is represented by one or more specialized and advanced KSA's. Any lack of required knowledge, skills, and abilities represents a training need.

Four steps are taken to identify the training needs among current and future maintenance supervisors:

1. Individual and potential supervisors are selected at random to represent, as samples, the personnel included in the training needs survey.
2. Tests are used to determine the extent to which the individuals in the samples possess the knowledge, skills, and abilities needed in the performance of their assignments.
3. Evaluations and appraisals are used instead of tests in connection with KSA combinations that do not lend themselves to testing.
4. Test, evaluation, and appraisal results are projected to obtain indications of the training needs of the supervisory and potential supervisory personnel represented by the samples.

Typical Sample—For purposes of this paper, it is assumed that 200 persons are employed as maintenance supervisors, and 800 are employed in the subordinate positions from which future supervisors will be selected.

So that the training needs of these two groups can be identified without testing and appraising each individual, two samples of employees are selected. Table 1 gives a typical

TABLE 1
TYPICAL DISTRIBUTIONS OF MAINTENANCE SUPERVISORS AND POTENTIAL SUPERVISORS, AND TYPICAL SAMPLES FROM EACH GROUP

Personnel Category	Statewide Force		Training Needs Sample		
	Number in Group	Percent of Group	Number in Group	Percent of Group	Percent of Statewide Force
Supervisors					
Foreman IV	10	5	6	8.5	
Foreman III	30	15	12	17.0	
Foreman II	60	30	20	28.5	
Foreman I	100	50	32	46.0	
Group total	200	100	70	100	35
Potential Supervisors					
Equipment operator IV	40	5	8	10.0	
Equipment operator III	80	10	12	15.0	
Maintenance man II	620	77.5	50	62.5	
Mechanic III	60	7.5	10	12.5	
Group total	800	100	80	100	10
Total	1000		150		15

distribution of supervisors and potential supervisors, and a typical sample selected from each group.

As indicated by the data in Table 1, the sample groups must be reasonably comparable to the employee groups they represent. If the total force is small, the sample must be relatively large, as when 60 percent of the Foremen IV are selected to represent the 10-man Foreman IV classification. If the total force is large, the sample group can be small, as when 50 persons are selected to represent the 620-man force of Maintenance Men II.

If the total supervisor force includes, say, 70 persons or less, it is worthwhile to test and appraise the total force. If the force contains upwards of 200 persons, a sample probably provides more accurate data than can be obtained by testing and appraising the total force. If the force includes upwards of 1000 persons, an 8 to 12 percent sample is adequate and manageable.

Testing—Most maintenance supervisors have been out of school for several years, many of them for 30 years or more. Tests used with such persons must be designed to insure the testing of knowledge, skills, and abilities needed to do work, not knowledge, skills, and abilities needed to take tests. Most superiors have evaluated subordinates for purposes of salary increases and promotions. Evaluation systems used to identify training needs must be designed to overcome previous conditioning, if training needs rather than other characteristics are to be identified by evaluation. Finally, tests and evaluations are effective in relation to certain KSA's only. Others, such as supervisory skill and public relations ability, probably are best appraised by the individuals themselves.

The most reliable indications of individual training needs are the objective indications obtainable through tests, as compared to the subjective indications obtained through evaluations and appraisals. Testing is preferred to evaluating and appraising—but only to the extent that valid and reliable tests can be developed.

Just as tests are preferred to evaluations and appraisals, performance tests are preferred to written tests. If a supervisor can perform a part of his work and thereby demonstrate his ability to do the work, he can show clearly his lack of a training need. If he cannot perform a part of his work in the test situation, it can be assumed that he has a training need. Some typical performance tests, if they are called for in the work situation, include establishing slopes on shoulders or ditches, and preparing or identifying batches of asphalt mix.

Typical questions used in maintenance supervisor training needs tests are shown below:

Basic Mathematics

1. Add the following numbers and fractions: $6 + 3\frac{1}{2} + 3.5$
2. $6\frac{1}{2}$ tanks of asphalt were used. The tank held 600 gallons. The asphalt cost 10 cents per gallon. What was the cost of the asphalt used?

Asphalt

1. Two types of asphalt have been placed on the Monitor's table. Name the two types.

Soils and Aggregates

1. Four samples of aggregate have been placed on the Monitor's table. Name the aggregate in each pan.

Manuals of Reference

Use the manuals provided by the Monitor to answer the following questions:

1. Where would you find instructions on how often to mow grass on the right-of-way?

Name the manual _____

Give the page number _____

The questions are short, clear, and highly job-related. Where possible, the written questions approach the performance type, as when the individual is asked to use a manual of reference in much the same way as he would use it in the work situation.

Written and performance questions are developed by persons having specialized knowledge about the work (the training needs committee) and edited by persons having specialized knowledge about testing (the project staff personnel). Care is taken to insure that the words, sentences, and sketches are appropriate to the education and reading levels of most participants.

So that each supervisor in the sample is tested and appraised in relation to the KSA's that apply to his own work assignments, his immediate superior identifies two groups of applicable specialized and advanced KSA's: those that apply to work assignments performed within the past two years, and those that apply to work assignments to be performed within the next year. So that each potential supervisor in the sample is tested and appraised in relation to the specialized and advanced KSA's that will apply to his first assignments as a supervisor, his superior identifies the KSA's most likely to be applicable during the first year after promotion. The supervisors and potential supervisors are then tested and appraised in relation to all of the 23 basic KSA's plus each applicable specialized and advanced KSA.

Persons tested are permitted to use any books, tools, and equipment available to them in the normal course of their work. Further, they are permitted to do anything that will help them overcome any apprehensions they may have about the tests--except what would indicate they know answers they do not know, or have skills that they do not have. Their deficiencies represent their own trainings and the training needs of others in the total employee force.

Tests are organized so that each test section represents a specific KSA. The test sections are scored as follows:

A score of 1 represents a training need in connection with the respective KSA that should be fulfilled by specific employer action.

A score of 2 represents a training need of low priority, one that can be fulfilled when materials are developed for other persons more seriously in need.

A score of 3 represents possession of the knowledge, skills, and abilities needed for satisfactory work performance.

As can be seen, tests are scored only as necessary to identify existing training needs.

Evaluating and Appraising--Objective testing is preferred to subjective evaluations and appraisals. Since most tests are unreliable in such KSA's as record keeping, public relations, supervision, and first-level management, evaluations and appraisals are obtained.

Evaluations are obtained from the immediate superior on those KSA's in which he feels confident about his knowledge of the individual. Self-appraisals are obtained in connection with those KSA's, particularly supervision and first-level management, in which the employee is himself the best judge of his training needs.

So that the evaluations and appraisals can be made as objectively as possible, the following steps are taken:

1. The participants are fully informed as to the objectives and the technology of the training needs survey.
2. The participants are fully informed as to the standard of training applicable to each KSA.
3. The participants are assured that the results will be held in confidence by the project staff. (All tests, evaluations and appraisals are identified by employee number. The employee identifications are separated from the survey materials to avoid the use of survey results in connection with such things as salary increases and promotions.)

The same scoring system is used for the evaluations and appraisals as is used for the tests:

A score of 1 represents a high-priority training need.

A score of 2 represents a low-priority training need.

A score of 3 represents no training need.

TABLE 2
TYPICAL SUMMARY OF BASIC KSA TRAINING NEEDS TEST RESULTS AND PROJECTIONS OF STATEWIDE TRAINING NEEDS

Personnel Category	Persons Tested	In Need of Training					
		Dept. -Div. -District Orientation		Maintenance Function Orientation		Terminology and Nomenclature	
		Number	Percent	Number	Percent	Number	Percent
Supervisors							
Foreman IV	6	1		—		—	
Foreman III	12	2		2		1	
Foreman II	20	10		9		7	
Foreman I	32	22		19		17	
Group total	70	35	50	28	40	25	35
Potential Supervisors							
Equipment operator IV	8	6		4		3	
Equipment operator III	12	9		6		5	
Maintenance man II	50	42		28		22	
Mechanic III	10	7		6		6	
Group total	80	64	80	44	55	36	45
Statewide Forces	Persons Represented			Projected Results			
Supervisors	200	100		80		70	
Potential supervisors	800	640		440		360	

Note: Only scores of 1 (representing high-priority training needs) were used.

Tabulating and Projecting Results—The results obtained from the sample employee groups are tabulated and projected to represent the results that would be obtained if the total force were tested, evaluated, and appraised.

Table 2 contains a summary of the results typically obtained when samples of current and potential maintenance supervisors are tested in connection with selected basic KSA's.

Table 3 contains typical summaries of training needs attributable to the specialized KSA's.

Concerning advanced KSA's, typically 80 to 100 percent of the first-line managers indicate a need for training in the principles and practices of management. Also, they indicate a preference for training first in the technical phases of road and bridge maintenance and then in the supervisory and management phases of their work. Most persons in this group are knowledgeable about that which is represented by the basic KSA's.

TABLE 3
TYPICAL SUMMARY OF SPECIALIZED KSA TRAINING NEEDS TEST RESULTS AND PROJECTIONS OF STATEWIDE TRAINING NEEDS

Personnel Category	Total Force	Sample Group	Base Repairs		Gravel Road Repairs		Asphalt Surface Repairs	
			Tested	In Need	Tested	In Need	Tested	In Need
Supervisors								
Foreman IV	10	6	6	2	6	1	6	1
Foreman III	30	12	4	2	3	1	6	2
Foreman II	60	20	8	3	9	3	10	4
Foreman I	100	32	12	6	10	7	16	12
Group total	200	70	30	13	28	12	38	19
Potential Supervisors								
Equipment operator IV	40	8	6	3	5	2	7	5
Equipment operator III	80	12	6	4	6	4	8	6
Maintenance man II	620	50	20	14	24	16	35	29
Mechanic III	60	10	—	—	—	—	—	—
Group total	800	80	32	21	33	22	50	40
Statewide Forces					Projected Results			
Supervisors	200	70	85	35	80	35	110	55
Potential supervisors	800	80	320	215	328	220	500	400

Note: Projected figures have been rounded to the nearest 5.

Summary of Needs—The following list contains a typical training needs summary— for current maintenance supervisors—the needs attributable to many KSA's have been deleted for purposes of brevity:

Basic KSA Training Needs	Number of Persons	Percent of Force
1. In the objectives and programs of the Department, the Maintenance Division, and the assigned district	100	50
2. In the basic technology of road and bridge maintenance	80	40
3. In the terms used to represent road and bridge structural elements and road and bridge maintenance activities	70	35
4. In road and bridge maintenance standards	140	70
5. In the classification and use of soils and aggregates	125	62
6. In the classification and use of asphaltic materials	90	45
7. In the use of portland cement concrete	160	80
8. In the use and capacities of highway maintenance equipment	120	60
9. In basic mathematics	115	57
10. In the calculation of areas and volumes applicable to maintenance work	135	67
11. In keeping records	135	67
12. In using reference manuals	85	42
Specialized and Advanced KSA Training Needs		
13. In base repair supervision	35	
14. In gravel road repair supervision	35	
15. In asphalt surface repair supervision	55	
16. In portland cement structure repair supervision	60	
17. In drainage maintenance supervision	85	
18. In right-of-way maintenance supervision	80	
19. In shoulder maintenance supervision	70	
20. In sign, signal, and markings maintenance	10	
21. In the principal practices of supervision	170	
22. In the basic principles of first-line management	10	

Analysis of the list indicates that the training needs attributable to any given KSA can be identified and, to a certain extent, quantified for analysis purposes and the training needs may range from only a few persons on one KSA to nearly the total force on another.

The following list contains a typical summary of the training needs attributable to potential maintenance supervisors who are drawn from the ranks of the equipment operators and mechanics. Percentages given are for persons who will actually be promoted to supervisory positions, as against percentages of the current force.

Basic KSA Training Needs	Percent in Need
1. In the objectives and programs of the Department, the Maintenance Division, and the assigned District	80
2. In the basic technology of road and bridge maintenance	55
3. In the terms used to represent road and bridge structural elements and road and bridge maintenance activities	45
4. In road and bridge maintenance standards	90
5. In the classification and use of soils and aggregates	85
6. In the classification and use of asphaltic materials	60

<u>Basic KSA Training Needs (continued)</u>	<u>Percent in Need</u>
7. In the use of portland cement concrete	80
8. In the functions and capacities of highway maintenance equipment	70
9. In basic mathematics	60
10. In the calculation of areas and volumes applicable to maintenance work	70
11. In keeping records	90
12. In using reference manuals	90

Most of these persons will need training in the basic KSA's. Perhaps the highest priority of need can be attributed to the use of reference manuals, the keeping of records, and the application of standards, but significant needs exist in relation to all basic KSA's.

A summary of typical training needs attributable to the specialized KSA's is not shown. As would be expected, almost all potential supervisors are in need of training relative to the specialized KSA's that will apply to their work assignments.

Summary of the Needs Identification Procedure

The principal steps involved in identifying the training needs of an employee force are summarized as follows:

1. Appoint a training needs committee and a project staff to carry out the survey. The members of the committee should be knowledgeable about one or more activities carried out by the maintenance supervisors; those on the project staff should be knowledgeable about training.
2. Identify every activity (job element) carried out by the maintenance supervisors, and the principal tasks performed in connection with each activity.
3. Identify the combinations of knowledge, skills, and abilities needed to perform each task (KSA's).
4. Develop highly work-related performance and written tests in connection with each combination of knowledge, skills, and abilities—except those for which testing is an unreliable method of identifying training needs. Supervisory, public relations, and management abilities are not easily measured by performance or written tests.
5. Develop evaluation and self-appraisal procedures for use in obtaining indications of the training needs attributable to such things as supervision, public relations, and management.
6. Select individuals at random from the forces of maintenance supervisors and potential supervisors, and use the tests, evaluations, and appraisals to obtain indications of their training needs.
7. Tabulate and project the training needs of the samples to represent the training needs of all maintenance supervisors and potential supervisors.

EMPLOYEE CHARACTERISTICS IDENTIFICATION PROCEDURE

The identified training needs of an employee force are one set of the principal data needed for planning an overall training program. The other data needed are those that reflect the characteristics and attitudes of the persons to be trained.

Among the characteristics that have bearing on the design of training programs are (a) the age, education, and experience distributions of the employees, (b) the relative capacities of the individuals to absorb training, (c) the prevailing attitudes of the employees toward training, and (d) the geographical locations of the employees. The final characteristics that influence the design of the training materials are the turnover and force expansion rates.

Age, Education, and Experience Characteristics

Age Distribution—The distribution of the simulated training population according to age is given in Table 4.

TABLE 4
A TYPICAL DISTRIBUTION OF MAINTENANCE SUPERVISORS AND POTENTIAL SUPERVISORS ACCORDING TO AGE

Personnel Category	Persons Employed	Years of Age					
		Less than 25 Years	25 to 34 Years	35 to 44 Years	45 to 54 Years	55 to 64 Years	65 Years and Over
Supervisors							
Foreman IV	10	—	—	2	2	5	1
Foreman III	30	—	2	5	12	10	1
Foreman II	60	4	8	16	20	10	2
Foreman I	100	11	9	24	34	17	5
Group total	200	15	19	47	68	42	9
Percent of group	100	7.5	9.5	23.5	34	21	4.5
Average age, weighted	47 years						
Potential Supervisors							
Equipment operator IV	40	—	2	11	12	14	1
Equipment operator III	80	1	7	24	30	18	—
Maintenance man II	620	61	59	150	216	111	13
Mechanic III	60	1	4	17	21	16	1
Group total	800	63	82	202	279	159	15
Percent of group	100	8	10	25	35	20	2
Average age, weighted	45 years						

Education Distribution—The distribution of the simulated training population according to education is given in Table 5.

Experience Distribution—The distribution of the simulated training population according to years of experience with the Department of Highways is given in Table 6.

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Capacity-to-Learn Characteristics

New training techniques have been developed which have successfully extended training to persons previously considered to be incapable of taking training. But limitations still exist with regard to the training of some individuals. Some specialists in training insist that even these can be trained, but the costs of training exceed the values to be obtained. In view of this, relationships have been established between individual capacities to learn and the training that will be provided to those individuals.

TABLE 5
A TYPICAL DISTRIBUTION OF MAINTENANCE SUPERVISORS AND POTENTIAL SUPERVISORS ACCORDING TO EDUCATION

Personnel Category	Persons Employed	Years of Education						
		0 to 4 Years	5 to 7 Years	8 Years	9 to 11 Years	12 Years	13 to 15 Years	16 Years
Supervisors								
Foreman IV	10	—	2	1	3	4	—	—
Foreman III	30	—	7	3	5	12	—	3
Foreman II	60	4	7	7	16	20	5	1
Foreman I	100	8	16	17	20	26	11	1
Group total	200	12	32	28	44	62	16	6
Percent of group	100	6	16	14	22	31	8	3
Average education level, weighted	9.7 years							
Potential Supervisors								
Equipment operator IV	40	7	9	14	8	2	—	—
Equipment operator III	80	12	16	29	18	5	—	—
Maintenance man II	620	103	87	103	119	207	1	—
Mechanic III	60	6	8	30	15	1	—	—
Group total	800	128	120	176	160	215	1	—
Percent of group	100	16	15	22	20	27	—	—
Average education level, weighted	8.2 years							

TABLE 6
A TYPICAL DISTRIBUTION OF MAINTENANCE SUPERVISORS AND
POTENTIAL SUPERVISORS ACCORDING TO EXPERIENCE

Personnel Category	Persons Employed	Years of Experience					
		Less Than 1 Year	1 to 3 Years	4 to 6 Years	7 to 10 Years	11 to 19 Years	Over 20 Years
Supervisors							
Foreman IV	10	--	--	--	1	3	6
Foreman III	30	--	--	1	3	7	19
Foreman II	60	--	5	7	9	28	11
Foreman I	100	2	3	9	24	60	2
Group total	200	2	8	17	37	98	38
Percent of group	100	1	4	9	18	49	19
Average experience level, weighted	14 years						
Potential Supervisors							
Equipment operator IV.	40	--	--	2	13	14	11
Equipment operator III	80	1	12	18	27	22	--
Maintenance man II	620	54	131	111	104	212	8
Mechanic III	60	--	1	6	15	33	5
Group total	800	55	144	137	159	281	24
Percent of group	100	7	18	17	20	35	3
Average experience level, weighted	9 years						

The Wonderlic Personnel Test, developed by E. F. Wonderlic, Northfield, Ill., provides an indication of the relative capacities of individuals to learn from training. It is one of the tests most widely accepted and used by governments and industry because there is a high correlation between performance in the test situation and in the learning situation, and it has been validated with groups of actually employed persons.

Wonderlic Questions—The Wonderlic Personnel Test consists of 50 questions. Sample questions drawn from various forms of the test are shown in Figure 1. (Eight forms are available.)

The test indicates each person's relative capacity to work with words, numbers, clerical data, statements in logic, and simple problems in geometry. Questions proceed from the simple to the more complex, placing premium values on high scores. Each participant is given 12 minutes to answer as many questions as possible. The number of correct answers given is the participant's test score. The attainment of high scores obviously is dependent on unusual ability with words, numbers, logic, and spatial relationships.

The Wonderlic Personnel Test has limited value when used to measure the relative capacities of persons to learn if the individuals tested have had little formal education or have been educated in other than the English language. This test is used with maintenance personnel, but measures less dependent on reading ability are needed for some personnel.

Wonderlic Score Interpretations—Scores can be interpreted as follows, with special interpretations needed for those individuals who have had limited formal education or have language difficulties:

1. Scores of 1 to 6 indicate very limited capacities to learn. Persons with these scores can usually be taught to use hand tools.
2. Scores of 7 to 11 indicate capacities to learn equivalent to those needed by truck drivers, messengers, and supervisors of common laborers.
3. Scores of 12 to 17 indicate capacities to become equipment operators, mechanics, and day-to-day supervisors of single maintenance crews.
4. Scores of 18 and above indicate capacities to become highly skilled equipment operators and mechanics, and supervisors of two or more maintenance activities.
5. Scores of 24 and above indicate capacities to learn the planning, scheduling, and controlling functions well enough to direct a large road and bridge maintenance force.
6. Scores of 30 and above indicate capacities to learn the principles of management.

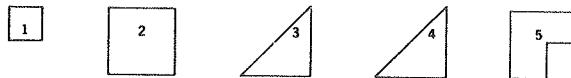
In the following set of words, which word is different from the others?
 1 cinnamon, 2 ginger, 3 clove, 4 tobacco, 5 mint []

How many of the five items listed below are exact duplicates of each other? []
 Patterson, A. J. Paterson, A. J.
 Smith, A. O. Smith, O. A.
 Bleed, O. M. Bleed, O. M.
 Petersen, O. W. Peterson, O. W.
 Cash, I. O. Cash, I. O.

Assume the first 2 statements are true. Is the final one: (1)true, (2>false, (3)not certain?
 Fred greeted Mary. Mary greeted Ned. Fred did not greet Ned. []

A train travels 60 feet in $\frac{1}{5}$ second. At this same speed, how many feet will it travel in 3 seconds? []

Three of the following 5 parts can be fitted together in such a way to make a triangle. Which 3 are they? []



A dealer bought some cars for \$2500. He sold them for \$2900, making \$50 on each car. How many cars were involved? []

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Figure 1. Typical questions selected from the Wonderlic Personnel Test.

These values must be used with discretion. Capacity to learn is affected by motivation and willingness to learn. Persons who score in the 12 to 17 range may be as trainable as those scoring in the 24 to 29 range, because of unusual personal drive. In contrast, persons who score in the 24 to 29 range may be only as trainable as those who score in the 12 to 17 range, because of lack of interest.

Typical Wonderlic Test Results—The distribution of the simulated training population according to their Wonderlic scores is given in Table 7.

TABLE 7
 A TYPICAL DISTRIBUTION OF WONDERLIC PERSONNEL TEST SCORES

Personnel Category	Persons Employed ^a	Scores 1 to 6	Scores 7 to 11	Scores 12 to 17	Scores 18 to 23	Scores 24 to 29	Scores 30 and above
Supervisors							
Foreman IV	10	—	—	—	2	7	1
Foreman III	30	—	1	5	11	11	2
Foreman II	60	—	2	9	19	26	4
Foreman I	100	—	5	19	39	31	6
Group total	200	0	8	33	71	75	13
Percent of group	100	0	4	17	35	37	7
Potential Supervisors							
Equipment operator IV	40	—	—	2	24	12	2
Equipment operator III	80	1	2	21	39	15	2
Maintenance man II	620	23	52	107	167	240	31
Mechanic III	60	—	1	23	18	14	4
Group total	800	24	55	153	246	261	39
Percent of group	100	3	7	19	31	35	5

^aDistributions in this table imply that all personnel in a training population are tested. Actually, only a sample needs to be tested to obtain indications for the total force.

The data in Table 7 indicate the following:

1. Four percent of the current supervisors achieved scores of 7 to 11, indicating limited capacities to learn the technology of maintenance, or the need for paying special attention to a language or reading problem in developing training materials.
2. Seventeen percent of the supervisors attained scores of 12 to 17, indicating potential to learn those things necessary to becoming equipment operators and mechanics, or providing day-to-day supervision to single crews.
3. Thirty-five percent of the supervisors achieved scores of 18 to 23, and 37 percent achieved scores of 24 to 29, indicating ample capacities to learn to supervise several crews and to do the planning, scheduling, and controlling necessary for an extensive maintenance program.
4. Seven percent of the supervisors achieved scores of 30 and above, indicating management potential.
5. Ten percent of the potential supervisors probably would have difficulty taking technical training of any kind, and 19 percent probably should, at best, be limited to small gang supervision.
6. Seventy-one percent of the potential supervisors achieved scores of 18 and above—a number sufficient to provide the maintenance supervisors needed to fill all foreseeable future vacancies.

Training Approach Characteristics

Several other characteristics of the employee force determine many of the characteristics of the final training program. Among these are the attitudes of the employees toward training and their opportunities to take training, the locations of the persons to be trained, and the numbers of persons that will be in need of the same training in the foreseeable future.

Attitudes and Opportunities—Questionnaires and interviews have revealed the following attitude and opportunity-for-training characteristics of maintenance supervisors:

1. They prefer individual or small group training, usually because they have been away from classroom instruction for many years.
2. They can be expected to accomplish little through home study, because few of them have the necessary privacy.
3. They can be expected to accomplish little through the normal correspondence school and adult education channels, because they have difficulty translating concepts and practices that apply to industrial situations into situations that occur in the maintenance function.
4. They can be expected to pay little, if any, of the cost of training, because their incomes are usually committed to other things.
5. They will be highly receptive to training, particularly if the training is highly job-related and specific and if it is presented in terms they can understand.
6. They have ample opportunity to take training during regular working hours, if the training is designed to permit individuals to train themselves or to train in small groups, and if training can be interrupted from time to time for the performance of work.

Locations—Highway departments have shops and stations located throughout their respective states, provinces, counties, and cities. Maintenance supervisors also are dispersed geographically, sometimes to more than one hundred locations.

Expansion—Actual data have not been collected to document the rates of expansion of the maintenance supervisor forces in different highway departments. Nevertheless, it is clear that two types of expansion are taking place: an expansion of the duties and responsibilities delegated to individual supervisors as the maintenance workload is increased, and expansion of the numbers of supervisors employed.

Turnover—Typical turnover rates among the maintenance supervisors run from 6 percent to 15 percent or more of the total force. The numbers of new supervisors needed as replacements exceed these rates slightly, to provide for a few persons who are advanced temporarily.

Summary of the Characteristics Identification Procedure

The following characteristics of a maintenance supervisor force influence the characteristics of the final training program:

1. Age, education, and experience distributions,
2. Capacity to absorb training,
3. Attitudes toward training and opportunities to take training,
4. Geographical distribution, and
5. Rate of expansion and of turnover.

Data relative to these characteristics are obtained from the personnel records, from tests, questionnaires, and interviews.

TRAINING PROGRAM PLANNING PROCEDURE

The objective of training is the development in the supervisors of the performance capabilities needed to do the work. The development of a plan for training involves (a) summarizations of the data that have bearing on the training problem, (b) analysis and interpretation of the summarized data, and (c) preparation of a framework of policies, specifications, and organizational relationships for training.

Summary of Collected Data

The data collected relative to the training needs and the training-related characteristics typical of maintenance supervisors are summarized below, together with data relative to future training needs.

Summary of Training Needs—The training needs of the maintenance supervisors can be summarized briefly as follows:

1. Maintenance supervisors, as a group, have responsibility for 25 or more major work activities, and have need for 50 or more combinations of knowledge, skills, and abilities.
2. Maintenance supervisors, individually, have need for 23 combinations of basic knowledge, skills, and abilities and at least one (but sometimes 10 or more) combination of specialized knowledge, skills, and abilities.
3. Current maintenance supervisors typically have need for training in the basic and the specialized knowledge, skills, and abilities, with special reference to the standards applicable to the maintenance function, and the materials, equipment, and methods used in road and bridge maintenance.

Summary of Characteristics—The maintenance supervisor characteristics that have significance in relation to the training effort are summarized as follows:

1. Persons to be trained range in age from less than 25 to more than 65 years; in education, from less than 4 to as many as 16 years; and in maintenance experience, from less than 1 to more than 20 years.
2. They range in learning capacity from that needed to become useful on the simplest types of labor to that needed for advanced management responsibilities.
3. For the most part, they are (a) apprehensive about classroom and large-group training, (b) unable to take training at home or after working hours, (c) unable to pay the costs of training, (d) unable to relate available correspondence school and adult education courses to the maintenance function, and (e) very willing to take training if it is highly job-related and is directed at their specific training needs.
4. They are dispersed throughout a sizable geographical area.
5. They have ample opportunity to take training during regular working hours, if the training materials are designed for individual or small-group self-training, and if the training can be interrupted as necessary for the performance of work.

Summary of Future Needs—Indications of the future training needs attributable to the maintenance supervisor force can be summarized as follows:

1. There consistently will be need to retrain individuals to restore capabilities lost through periods of disuse.
2. Revision of training materials to reflect changes in standards, materials, equipment, and methods will be necessary.
3. There will be need to expand the performance capabilities of many current supervisors.
4. It will be necessary to train new supervisors to fill new positions and to fill positions vacated through turnover—this may represent 8 to 15 percent of the current training needs.
5. The persons to be advanced are reasonably identical to the current supervisors in terms of age, education, maintenance experience, capacities to absorb training, and attitudes toward training.
6. The persons to be advanced are less knowledgeable about maintenance work and less able, without further training, to supervise maintenance work than are the current supervisors.

Analysis of Data

Training Needs Data—The training needs data indicate that (a) technician-supervisors are needed for the maintenance function and (b) a program of training that encompasses all of the knowledge, skills, and abilities needed by maintenance supervisors should be developed.

Technician Supervisors—The existence of 25 or more major maintenance activities and 50 or more combinations of knowledge, skills, and abilities indicates that the maintenance function is highly diversified and technical. Maintenance supervisors have need to be technically trained. In addition, they have need to be effective supervisors, with special reference to the effective utilization of manpower, equipment, and materials.

Total Program—None of the 50 combinations of knowledge, skills, and abilities can be omitted. Some combinations are of a higher priority than others, but the development of fully qualified technician supervisors is dependent on the development of a training program that includes all of the subject matter represented by the 50 KSA's.

Employee Characteristics Data—The employee characteristics data indicate that special care must be taken in the development of the training courses and materials. The characteristics that dictate special care are the age, education, and experience variations, the learning capability variations, the attitudes toward training, and the opportunities for training. Consideration must also be given to the geographical dispersion of the personnel.

Age, Education, Experience—Obviously, persons less than 25 years old have an advantage over persons 50 to 65 years of age in the classroom. Attempts to treat them alike usually will fail. It seems best to design much of the training (at least in the early stages) so that these persons can be trained individually or in small, compatible groups.

Just as obviously, persons who cannot read and write cannot successfully be grouped with high school and college graduates for training purposes. It is almost as difficult to work with persons ranging from four years to ten years in education. It is necessary to (a) provide for individual training where feasible and small group training where necessary, (b) use terms and words common to the group and carefully define any new terms, and (c) organize the subject matter in increments appropriate to the persons to be trained.

The variations in maintenance experience are important from a motivation standpoint. Individuals with long experience have difficulty taking training together with individuals with limited experience. In addition, experienced personnel have difficulty in accepting new concepts. The variations in experience can best be overcome by providing individual and compatible small-group training and by insuring that the subject matter is fresh, complete in details, consistent, practical, and workable.

Learning Capability—Just as persons with vastly different age, education and experience characteristics should be treated separately in the training situation, persons with vastly different learning capabilities should be treated separately. Some current maintenance supervisors and some potential maintenance supervisors should not be

trained. Typically, 25 to 35 percent of the supervisors who need training, and upwards of 35 percent of the potential supervisors who need training, can benefit very little from training.

Most current maintenance supervisors and more than an adequate number of potential supervisors can readily be trained. To overcome the differences that exist in their learning capabilities, they should be trained individually, or in small, compatible groups. Individual and small-group training permit maximum concentration on the segments of training that give difficulty, and self-pacing avoids leaving the slow learners behind and the fast learners bored.

Attitudes and Opportunities—The considerations that must be given to the employee attitudes toward training and the employee opportunities for training are as follows:

1. Training should be accomplished during regular working hours and, insofar as possible, at the regular places of work.
2. Training costs should be paid by the employer.
3. Training should be specific in relation to the training need. People who take training in areas in which they are already knowledgeable are usually adversely affected when taking needed training.
4. Training should be appropriate as to time. Training that greatly precedes the need is less effective than training provided just in advance of need. Training that follows the need is of little value.
5. Training should be highly job-related.
6. Training should, insofar as possible, be self-pacing and should permit self-scheduling.

Locations—The geographical dispersion of the persons to be trained causes two problems: scheduling and providing for uniformity. As to scheduling, classroom training is difficult to arrange when the persons involved have supervisory responsibilities. With regard to uniformity, it is clear that the best results are obtained if the subject matter of training is identical from trainee to trainee, location to location, and year to year. This cannot be achieved, more than in part, if instructors are used. From a training standpoint, it seems best to develop self-instructional materials and self-operating workshops.

Future Needs Data—The data relative to future training indicate the following considerations:

1. The training courses and materials should be designed so that changes can be made in the subject matter as changes occur in the technology of maintenance and subject matter that remains stable for several years can be developed once and used as long as it is satisfactory.
2. The same training needs continue to occur year after year, although in reduced amounts, indicating that permanent training materials should be developed insofar as possible.
3. The total training effort needed is large, but manageable.

Development of Framework for Training

The framework for training includes the policies, program specifications, and training organization.

Policies for Training—The data analyses and interpretations provide the policies for training:

1. Training is recognized as a permanent and integral part of the total maintenance workload.
2. Training shall be accomplished during regular working hours at no out-of-pocket cost to the employees.
3. Training shall be administered by the operating organization.
4. Training shall be specific as to the subject matter needed and appropriate as to the time of need. Individuals shall be required to take only that training which provides the knowledge, skills, and abilities required for the performance of assigned work.

5. The training materials shall be revised as necessary to incorporate changes in maintenance technology.

Specifications for Training—The specifications for training are taken from the training needs and employee characteristics data, and from the policies for training:

1. Each course of training shall include the subject matter representing the training needed by a significant number of maintenance supervisors, but shall be so limited that few supervisors will be required to take training in one subject matter area in order to obtain training in another.

2. The subject matter of each course shall be limited to that needed for satisfactory work performance, shall include all that is needed, and shall be set forth in terms and examples taken from the work situation.

3. The courses of training shall be organized in series, so that prerequisite courses are identified clearly, and so that individuals can develop their performance capabilities in a logical sequence.

4. Individual self-instruction techniques shall be given first preference in the selection of presentation methods, followed successively by small-group self-instruction, monitored small-group instruction, and classroom instruction.

5. Training materials and self-operating workshops shall be made available at the locations nearest to the personnel to be trained, subject to considerations of costs.

Organization for Training—The maintenance supervisor training organization should consist of subject matter experts, training specialists, and the operating managers.

Subject Matter Experts—A committee of persons thoroughly knowledgeable about the maintenance of roads and bridges should be established. The function of this committee is outlined as follows:

- To provide guidance and assistance to the training personnel responsible for the collection of subject matter by indicating work under way that can be studied, persons who can be questioned, and samples, diagrams, and models that can be obtained.
- To review subject matter that has been "shaped-up" by the data collection personnel before it is incorporated into training materials.
- To conduct field research and field testing as necessary to fill in gaps in the subject matter.
- To develop standards for the maintenance function where none exist and to improve existing standards, or to submit standards problems to a research organization for solution.
- To approve the subject matter included in training materials.
- To indicate changes that should be made in existing training materials.

Training Specialists—The training specialists should include a subject matter expert, two data collectors, and one or two training specialists.

The subject matter expert should be an engineer from the maintenance organization, or someone professionally trained who can assimilate maintenance technology quickly. This person should plan the data collection; review the collected data to insure that it is reasonably complete, consistent, and practical; conduct research to fill in gaps in the data; and recommend additional research as necessary. He should assist the subject matter committee on all review and development work, and be available to the writers while the final training materials are being developed.

The data collectors should work with the operating maintenance supervisors to obtain the subject matter for training. They should observe work under way, interview operators and supervisors, collect samples, take pictures, develop diagrams, and do those things necessary to record data about maintenance technology. They should also check the collected information against the specifications, directives, manuals, and other references available from the central maintenance organization.

The training specialists should be knowledgeable about the principles of learning and the technology of training. They should be skilled in organization of subject matter for training, in developing training materials (including visual and audio materials), and in validating, editing, and preparing materials for duplication.

Operating Managers—The operating managers should be responsible for implementing the training program.

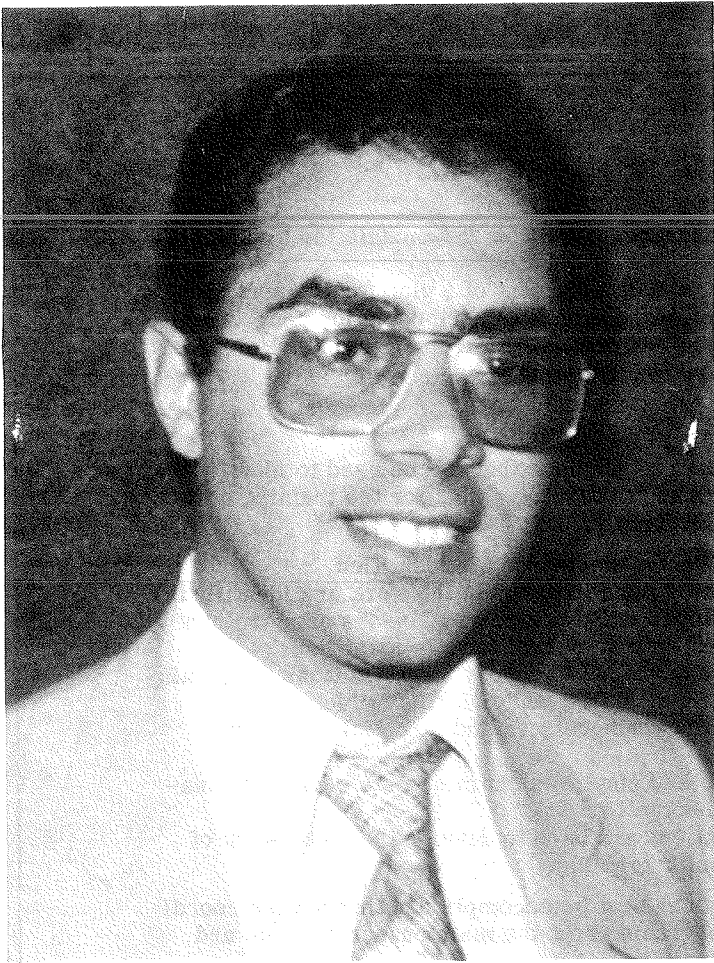
To summarize the planning procedure, the development of a plan for training involves itemizing the data relative to training needs and trainee population characteristics, analyzing and interpreting those data, and preparing a framework of policies, specifications, and organization relationships for training.

SUMMARY OF PAPER

The objective of this paper is to set forth a technique that can be used to identify the training needs of maintenance supervisors and to develop a plan for the training of those supervisors. Seven principal steps are involved:

1. The work performed by the maintenance supervisors is identified.
2. The knowledge, skills, and abilities needed to perform the work are identified.
3. The extent to which currently employed maintenance supervisors need training in connection with the required knowledge, skills, and abilities is identified.
4. The extent to which personnel to be advanced to supervisory positions need training in connection with the required knowledge, skills, and abilities is identified.
5. The characteristics of the maintenance supervisors and potential supervisors are identified.
6. The work analysis, training needs, and employee characteristics data are analyzed and interpreted from a training standpoint.
7. The data, analyses, and interpretations are used to develop the framework of policies, specifications, and organization for training.

The conduct of a training needs survey can best be accomplished through the coordinated effort of persons thoroughly knowledgeable about the maintenance function and persons thoroughly knowledgeable about training.



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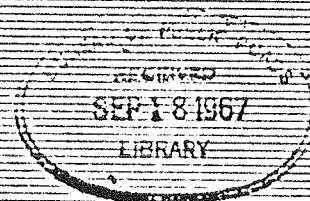
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VIRGINIA DEPARTMENT OF HIGHWAYS

Virginia Maintenance Study

1963 - 1966

PART IV OF THE
FINAL REPORT



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MANAGING HIGHWAY MAINTENANCE

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VIRGINIA

(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

Prepared by

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highway engineering and management consultants

DECEMBER 1966

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Bureau of Public Roads.

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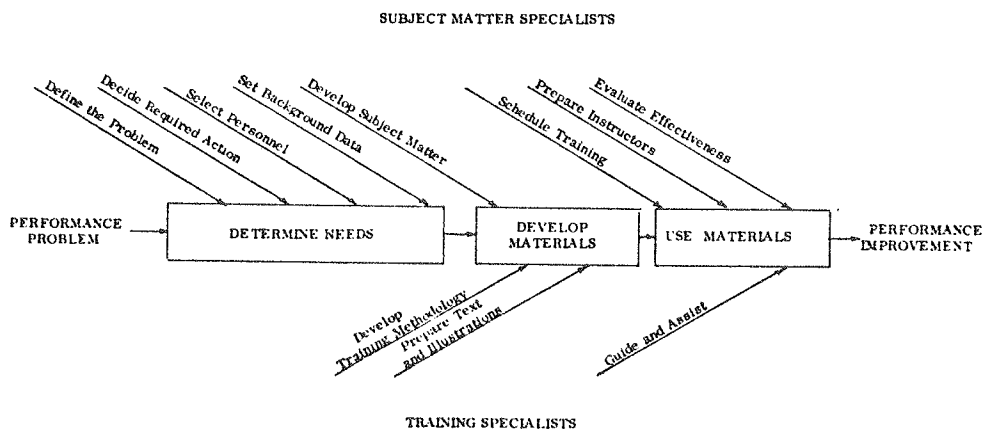
PERFORMANCE-ORIENTED TRAINING



The approach taken in this Study to training is that maintenance training is carried on to improve performance. Therefore, the training development is one alternative where action is required to attain improved performance where need is shown by operation of the management system.

The development of training materials and their use requires contributions from maintenance people and from specialists in training and training methodology. The maintenance personnel — both field and central office — act in the capacity of subject matter specialists, while training specialists from the Personnel Division provide the expert assistance line managers need.

The following diagram illustrates the development of training materials within the concept of the maintenance management system. It shows the various contributions required of subject matter specialists and those of training specialists, leading from the initial identification of a performance problem to improved performance — the objective of training.



As illustrated in the diagram, the major steps involved in the development and use of training materials are:

1. Determination of Training Needs — including full definition of the problem, non-training approaches to solution, personnel involved and the use of materials for developing new personnel.
2. Development of Training Materials — including the evaluation of the problem in terms of the man to be trained; the knowledge, skill and ability he requires to do his job; the actual production of training materials; illustrations and the selection of the appropriate training methodology.
3. Utilization of Training Materials — the means to be used in conducting training and the techniques for evaluating and testing training materials.

These steps are discussed in chapters nine, ten and eleven of this section.

In Chapter Twelve recommended training policies and procedures and a training plan are presented. A bibliography of the materials developed by the project and sample extracts from the materials are presented in Appendix C.

Chapter NINE

DETERMINATION OF TRAINING NEEDS



A process has been developed to assist in determining training needs using performance reports from the management system. The System provides for evaluating performance in three ways: (1) rates and unit costs of doing work, (2) amounts of work done, and (3) the workmanship aspects of performing maintenance operations. Comparison of actual performance with standards may indicate the broad character of a performance deficiency, but it will not specifically isolate the reasons for sub-standard performance.

In the study project, the determination of training needs proceeded step by step as follows:

1. Define the problem, isolating the specific cause(s) of sub-standard performance.
2. Classify problems either as representing a training need or subject to less expensive management solution.
3. Identify those employees needing training.
4. Identify developmental training needs as well as specific problem oriented needs.

The considerations involved are best described by case examples encountered as a part of the training research. The succeeding sections deal with these cases.

PROBLEM DEFINITION

A problem manifests itself initially in data or personal observation but further investigation and review by field managers is virtually always required before the true nature of the problem is known. Though the Maintenance Division carries on investigations, most investigative effort is dependent upon field personnel. These are the men directly responsible for work performance and the individuals most directly concerned with training as a means of improving performance.

Evaluation of Unit Costs

During early research phases, wide variations in unit costs for the same work activity were regularly noted.* The variations in and of themselves were not definitive. But, the variations indicated both a problem and the improvement potential through upgrading performance to attain the current best cost levels.

In Part II of the Virginia Maintenance Study a process of analysis was developed to draw cause/effect relationships to unit cost variations. The skin patching work activity is an excellent example of the kinds and amounts of investigation required simply to define the problem.

In performing skin patching a number of factors could cause performance differences. Many were examined, including: the effects of road class and additional flagmen, the time of the year and relative importance of patching to other operations, the intensity of patching or conversely the amount of travel time required to go from patch to patch, and the effects of workmanship as measured by rates of application of materials. However, when data were developed on crew organization (number of men and trucks used), a close relationship with unit costs was established. Methods research indicated that a general ratio of two men per truck used in skin patching produced consistently better rates than when more labor was used. Spot checks of timesheets, accomplishment (time) studies of operations and field observation confirmed the relationship.

It was at this point that a specific cause of high unit costs could be defined, and the originally noted variations became significant. Any less specific definition of the problem would not have served the needs of training. Therefore, a general conclusion can be drawn that the work should be analyzed and the effects of methods on work performance determined.

* Part II of the Virginia Maintenance Study, Performing Highway Maintenance Operations is devoted almost exclusively to this problem.

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Evaluation of Quantities of Work

Variations in maintenance work quantities with respect to the same road class and quality standard are far greater than was recognized before the Virginia research was undertaken.

Quantities of work performed result from a combination of controllable factors. It is obvious that no two road sections, even with comparable age and traffic, will react in exactly the same manner and require identical amounts of patching. However, it has been found that a significant mileage of a particular road type will on the average require a predictable amount of patching. When data show inexplicable variations from such averages, the variations must result primarily from the judgment decisions of the local supervisor. In this situation there is obviously a need for standardizing the framework for decisions. Then, future performance variations may be expected to reflect only the results of uncontrollable conditions.

Mowing provides an example of this situation. Data obtained during 1963-1964 showed a range in the average number of times high type two-lane primary roads were mowed of 1.6 to 6.7 times. On other types of road, the range was even greater.

The Department's policy for mowing classifies the right-of-way into three parts: (1) a frequently cut portion where the height of grass is the determining factor, (2) a portion which should be cut about twice a year if required, and (3) a further portion consisting of difficult to reach and out of view parts which should not be cut as a part of the mowing program.

This policy was the result of an investigation, motivated by performance data, which indicated the differences in amounts of mowing were the result of lack of definition (1) of areas to be mowed, and (2) the height of grass to be tolerated. The policy further set priorities defined by the character of the traffic served by the road.

Thus, analysis of the performance data and definition of the problem established the need for clear instruction of personnel with regard to the policies and their application.

Evaluation of Workmanship

A case illustrative of workmanship considerations and their conversion to well defined training needs is the quality of shop made premix materials. In Virginia, RC-2 asphalt is generally stocked in the areas for general use. Aggregates of various sizes and specification are provided on open order with local quarries.

Premix materials are generally made using RC-2 and an aggregate which is normally specified for surface treatments. The premix is made with a small

pugmill mixer, either towed to the work site or used in a semi-permanent yard location. The stone is not normally dried as a specific step, and with the low fire point of RC-2, there is a reluctance on the part of maintenance employees to heat the stone very much or to have fire in the mixing chamber to drive off volatile materials.

The mix thus made is customarily placed in thin overlays with little or no preparation of the surface. Old surface materials which are obviously loose often are not removed before patching. From an engineering point of view, the resulting patches often leave much to be desired, although they have been found to have a high degree of permanence and to perform under traffic better than would be expected.

Preliminary observation to define the problem indicated a number of differences in the way crews made mix with similar materials and equipment. Some would heat stone only in the winter months. Some regularly applied flame to the aggregate, then cut off the flame and added asphalt. Others lit the flame only after the asphalt had been pumped in. Still others kept a flame in the mixing chamber at all times.

The specific problem of workmanship noted was a tendency for patches to be fat -- to such an extent that some patches will show through seals and overlays. From preliminary observations it was thought this was due to improper asphalt or poor handling of the asphalt leaving volatiles in the resulting mix.

Further consideration noted that maintenance employees avoided thick patches because of density problems. Field and laboratory trials developed an aggregate gradation suitable for use in maintenance mixes -- a gradation since recommended by one Assistant District Engineer for Maintenance for use as a specification material.

Preliminary training considerations were concentrated in the handling of equipment and materials. As a result of the field research, the resulting training emphasizes preparation of the road, general properties of materials, asphalt contents, patching limits and considerations other than the equipment or the materials.

CLASSIFICATION OF PROBLEMS

From the start, the study project staff was cognizant of the expense of preparing and conducting training and that such expense is unwarranted when the problem could be solved by a relatively simple statement of decision communicated as a part of routine direction of work. It is apparent that had training in preparing premix materials been prepared according to the original appraisal of the problem, the resulting training would have been related to improper materials. In this case, the performance change desired would not have resulted from the training.

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The solution is now one of both training and management communication as a result of the investigation and analysis of the problem. A new specification can be installed by letter. The training materials now concentrate on preparing the surface and the extent to which a portion of road should be patched -- in other words, it is concerned now with taking advantage of the new knowledge gained.

In contrast to this situation, under other conditions what had been thought to be a relatively simple matter of communication has shown itself to be a rather complex training problem. A snow and ice control standard was developed which set forth application rates for chemicals under varying conditions. These were in pounds per lane mile, the most commonly used being 500 pounds of salt per two-lane mile. Even with this standard in effect and mailed out to all field offices, widely varying amounts of salt being used under essentially similar conditions were observed. Data show chemicals use for nine residencies on a tons of salt per lane mile of priority one road per day of salting to be:

Residency	1	2	3	4	5	6	7	8	9
Tons/lane-mile/day	0.06	0.16	0.21	0.08	0.09	0.24	0.19	0.09	0.25

The problem had not been well enough defined, and the simple instruction of how many pounds to the mile to use was inadequate. As a result, further review of the problem centered on calibration of spreaders. A yard trial of spreaders was scheduled with the cooperation of a Resident Engineer and a Residency Maintenance Supervisor.

The spreading equipment used by Virginia is modern equipment similar to that used by many other states. The spreaders are hopper type which slip into the bed of the truck when needed. They have their own power unit. The adjustment lies characteristically in control over the engine speed and the amount of opening at the rear gate.

The first trial was conducted with the gate opening on the bed as it was when hung up for the summer. The engine was throttled by its governor. The materials flow under these conditions was 810 pounds of NaCl per minute. In response to a question from one of the maintenance personnel as to how fast you would have to go to get 500 pounds to the mile at this setting, the answer was 97 miles per hour.

Further efforts established the characteristics of the equipment and resulted in gate settings for truck speeds of 15, 20 and 25 miles per hour. An additional outgrowth of the trials was identification of a significant lack of understanding on the part of the operators of the relationship between truck speeds and fixed discharge rates on the road application rates obtained. An example of this was an operator who cared for a quite hilly road which headed southward. Upon questioning, he said the loaded truck slowed considerably going up hill, but he made up the time down hill. Later he commented that he had always wondered why the north slopes were bare before the south slopes on his particular road.

The general conclusion drawn from these examples is that investigation and definition of performance problems is a critical prerequisite to the eventual production of training that is actually needed and that will improve performance. Whether performance improvements require formal training effort or can be handled through less extensive and less expensive forms of communication can not be clearly established without this expenditure of effort. Whenever possible, routine management direction should be used, supplemented and clarified by each successive person in the link between the Division Office and the Area. It often may be worthwhile to attempt this even when it does not appear it will work. However, the reaction to such a communication must be evaluated and if the desired result is not obtained, the problem becomes one of training need.

EMPLOYEES NEEDING TRAINING

The process of defining the problem determines the reason for sub-standard performance. The next step, after assurance that it is a training problem, is to determine who it is that requires training to correct the problem. This is done by an appraisal of the decisions involved, establishing the employees who characteristically make that decision, and then evaluating whether or not they are capable of receiving the training indicated as needed.

Organizational assignment of responsibility is the determining factor. In the following sections examples of the considerations involved with different operating levels are presented.

Operators

Operators are the ones who make decisions on the road itself. Some of these decisions can be modified by the Superintendent in the way that he sets the crew up to go to work. However, there are carry-through decisions involved in many operations.

The following example serves to illustrate the case.

To apply the correct amount of chemicals for snow and ice removal requires that the bed of the truck be correctly set, the truck speed be maintained, and that the chemicals be placed in the proper place on the road. The first point is a decision of the Superintendent, deciding what kind of chemical or mixture is to be used and the appropriate application rate. The others depend upon the operator.

The initial instruction is to load a specific chemical, set the bed according to a table provided and the route assignment. The operator had to be taught to drive at the proper speed, to avoid trying to make up time — this resulting

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in a lower application rate than required -- and to place the chemicals at the high point on the road so the brine resulting can flow.

Superintendents

The Superintendent has the responsibility to schedule and dispatch working crews. When the problem centers around the way a crew is established, the training must be directed to the Superintendent.

The analysis of the skin patching methods -- crew organization -- showed that the proper relationship of men and equipment was the major factor in unit costs. This is set by the Superintendent. Beyond the original establishment of the crew, there are relatively clear additional instructions required which can be given by the Superintendent and do not require the involvement of patch crew members in the formal training. However, the Superintendent may well need to illustrate the reasons for the instruction.

Residency Supervisors

The Residency Supervisor is primarily concerned with the application of planning values and planning procedures to a specific area. The following case shows the type of training material directed to this level.

To gain economy of operations in snow and ice control requires that capacity be realistically established for each area. This must be done in such a way that the resulting plan provides the required framework for direction of operators and allows them to remain on the job a maximum amount of time without checking with the Superintendent. To do this, a planning procedure was established for use by the Residency Supervisor in working with his Superintendents. It provides basic planning values, the number of trucks required to cover a type of road, and the procedures for using this to prepare an area snow plan. The calculations and balancing problems make it necessary that the Supervisor do the actual work; and the carrying out of the plan requires that the Superintendent be involved.

Other Levels

Many of the problems noted in analysis are of the type that could have been solved by field direction had the engineers and supervisors been informed as to the nature of the information required. In many cases, the training is the result of specific investigation or research, which the engineers have no way of knowing about. It was found on the project that as a general practice, all training materials should be reviewed with all levels of the organization down to the level to which they are specifically directed. They should be considered as instruction at these levels in the same way as they are considered in the actual conduct of training.

IDENTIFY DEVELOPMENTAL TRAINING

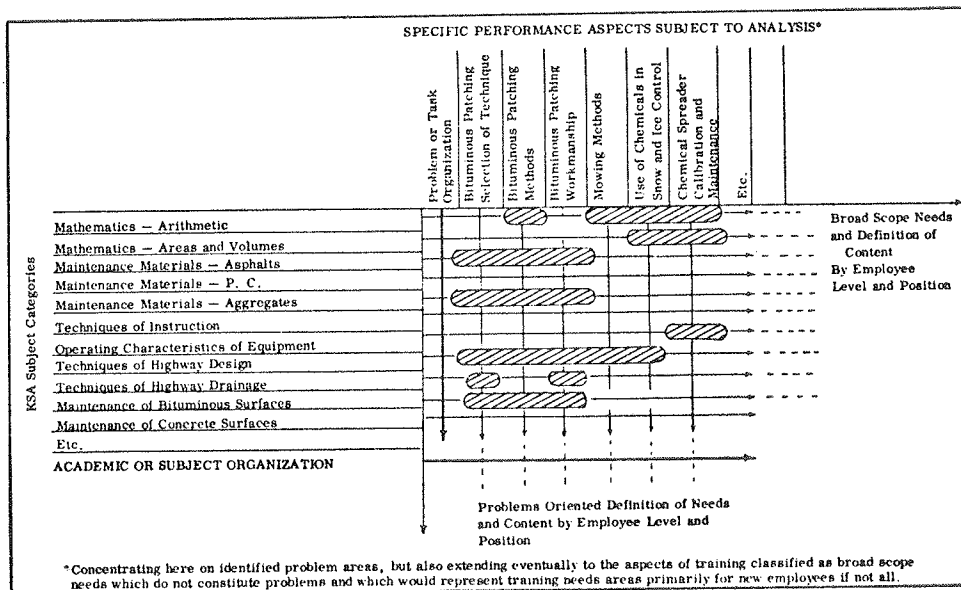
Analysis of performance problems leads to identifying training and communication needs affecting more than one problem. For example, the ability to solve simple mathematical problems has a direct bearing on a Supervisor's ability to check his rate of doing work in nearly all maintenance activities. Therefore, the process of determining training needs based on performance evaluation results in the identification of some needs which emerge as being extensive enough to justify differently organized training. These needs take on a logical order in terms of the knowledge, skill and ability* — KSA's — indicated, such as "Maintenance Mathematics."

Training needs crossing task or operation lines and training materials organized on a KSA basis are useful in developing a basis of knowledge, skill and ability in new maintenance supervisors and in preparing maintenance employees to be able to receive management direction as opposed to requiring training materials.

In essence, the differences in the two types of training need can best be illustrated by the two associated means of organizing the training materials; (1) problem or task organization, or (2) the more conventional and academic subject organization. The way in which these different classifications of needs relate to each other can be represented by the diagram shown in Figure 23.

Figure 23.

RELATIONSHIP BETWEEN TYPES OF NEEDS



* The term "Knowledge, skill and ability" is abbreviated as KSA throughout the report.

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To be most effective, training should be directed toward those portions of the total information in each KSA subject area which directly relates to the training objective. This applies both to training directed toward rapid improvement of specific performance aspects and to developmental programs devoted to filling KSA needs in a particular subject area across the board whether they represent problems at that time or not. Until this type of program is developed and implemented in the widely applicable KSA subject areas, those portions of each subject area directly related to improving performance must be incorporated into the problem oriented training materials. After development and implementation of the broad scope training, these segments of the problem oriented training may be dropped, or reduced in scope if there is advantage in doing so — particularly in terms of training time.

The identification of the employees to be trained and content of training needed must be evaluated in terms of both types of needs if maximum effectiveness in obtaining the differing training objectives is to be obtained.

Chapter TEN

DEVELOPMENT OF TRAINING MATERIALS

The development of training materials related specifically to a defined problem involves specific steps. These are:

1. Develop subject matter, gathering all information needed for the preparation of materials.
2. Select the method of training to be used.
3. Develop training materials, including text and illustrations in a form suitable for use by line personnel.

The three steps in developing training materials do not take place in a rigid chronological order. Basic subject matter must first be developed and approved by the Maintenance Engineer as training content. However, as the other steps are taken, additional subject matter needs will often be indicated. In all cases, the guide for this type of training is to tell the personnel how to do their job — thus the performance orientation of the material.

DEVELOPING SUBJECT MATTER

The development of subject matter requires that the problem definition, the solution to the problem, background information required to use the solution and the particular needs and abilities of the people to be trained be brought together. This should be a cooperative effort of the subject matter (maintenance) personnel and the training specialist, with the maintenance personnel providing the detailed information needed and the training specialist assuring that the infor-

mation is stated in terms understandable by the potential trainee. In this process there are a series of actions and decisions required. These are:

1. Determine the extent to which required information is in existence and agreed upon, and decide what to do about information gaps.
2. Gather information both from established sources and from research, organizing and rewriting it as necessary so that it is in terms and context understandable and practical from the user's point of view.
3. Develop supporting material required to explain the information in the training situation, and to motivate the trainee to learn and use the information.
4. Develop and provide information related to basic knowledge as required effectively to implement operations oriented training.

Determining Availability of Information

A significant conclusion of the training research was that identifying the knowledge, skills and abilities required in a training situation does not per se assure that the information required for training is available. Particularly likely to be missing is information directly related to the actual performance of the work.

An example of this was encountered in the application of asphalt using a hand hose for skin patching. While the technical requirements for desired performance were clear (0.25 gallons of asphalt per square yard), information as to how this might be obtained or measured under circumstances where hand hoses are used was totally lacking. The only way available in the job situation was to measure the size of all patches laid for a day and compare it to the amount of asphalt used. This was done in the case of a number of accomplishment studies which indicated a general application rate of 0.5 gallons per square yard or more. However, precise measurement is generally impractical for the maintenance employee, considering the time and difficulty involved in measuring the patches.

When this type of situation was encountered in the collection of information, a decision was required. The alternatives were:

1. Set up and conduct a research effort directed toward specifically obtaining the information required — deferring the development of training materials until results are obtained.

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2. Defer further development of materials until a modest effort can be made to find an interim solution for use until more information can be obtained.
3. Disregard the information gap, concentrating on the development of training including all pertinent related information requiring operating personnel to develop solutions on the job through application of this increased knowledge.

For the example discussed above, decision fell in the second category. Further research will result in a more definite solution of the problem than that discussed later in this chapter. The problem in deciding to use available information or to seek additional information is to compare the potential costs, time requirements and potential cost benefit of filling information gaps with the resulting delay and reduction of effectiveness of training produced. The validity of decisions of this type is dependent upon the adequate determination of training needs as outlined in the previous chapter.

Gathering and Reshaping Information

Gathering and reshaping information for subject material is divided into two phases. The first consists of extracting, reorganizing and rewriting information from available sources, and the second of developing usable information through research.

Two difficulties are often encountered in using information from available sources. On the one hand, there has been very little written on the technician level in the entire subject area of highway maintenance. Most of what has been written is highly technical, and while dealing at length with very complex and special situations, it often fails completely to answer the simplest questions. No effective means was found to resolve this problem.

The second problem in connection with available information is to obtain a synthesis of practice from a representative number of sources. It is a basic characteristic of maintenance that, without work analysis and standardization on a Statewide basis, the way of doing work has been developed by individual field engineers and supervisors. Consequently, often there are many different ways of doing the same thing.

The development of information through research may come from the results of highly technical and complex research efforts or relatively straightforward field observation and documentation of techniques in use. In the current project, the development of information on the proper application of asphalt for skin patching with a hand hose provides an example of the type of activity required of the training and subject matter specialists.

The project staff, with assistance from a Highway Research Engineer, performed field experiments and observed a number of crews at work to determine if a proper application could be obtained with a hand hose, and determine if a proper application could be described in terms usable by the operator on the job. Gauze panels of precise size and weight were laid out in a regular pattern over an area to be patched, and a skilled operator was directed to spray the area as though patching. An average application of very nearly that desired was obtained. However, the rate on the individual panels varied from approximately 0.18 to 0.35 gallons per square yard.

The critical elements of obtaining such application were found to be:

1. Correct height of the nozzle above the surface — approximately 18 inches. This was further defined as the height at which the edges of the fanning asphalt began to lose their outward motion and fall straight downward.
2. Speed with which the nozzle was moved across the patch — a good walking speed was approximately correct.
3. Having the nozzle already moving at this speed when beginning to spray.
4. Making a series of single, non-overlapping passes with the spray being cut off at the end of each pass rather than being allowed to continue spraying as the direction of the pass was reversed.
5. Not attempting to re-shoot small areas missed — avoiding a double application unless absolutely necessary.

A description of how a proper application looks on the road was determined concurrently with the experiments and field observations. It eventually took the form of a statement in the training material as follows:

"A good application should not flow on the road. You should be able to see the texture of the pavement underneath the sprayed asphalt — that is tiny bumps on the surface should raise tiny bumps in the asphalt application. If the surface of the application is smooth and glassy you have too much. When stone first is applied to it, the asphalt should come up only about a third of the way on the stone. Later when the stone is pushed down by a roller or by traffic it will flatten out and the layer of asphalt will come up 1/2 to 2/3 of the way around it. If the application is right it won't go beyond that and the patch won't be fat and slick — even after a long time on the road."

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Developing Supporting Materials

Information when gathered must be illustrated to be understood as training. The illustrations — photographs, sketches and charts, as well as the outlining of key concepts, is the responsibility of the training specialists. However, it requires the close cooperation of subject matter personnel to assist in conception of illustrations and to provide the point of view of the men to be trained.

When training is oriented to performance, the illustrations are dictated by the objectives of the training. This is contrasted to getting photographs and illustrative material and then building training about the material on hand. The project made no attempt at professional photography or illustration in that materials were being developed for pilot testing. However, the processes of determining what illustrations were required and the arrangements associated therewith were explored.

The first consideration of training is that instruction be by good example. This demands that photographs be taken of work being done properly and they illustrate only the central point of the text. In many cases, crews had to be instructed to do work in the way the Department decided was correct before a photo could be taken.

An example is the case of premix patch materials. Practice had been to overlay instead of removing old surface material to compensate for the lack of density in the mix. To illustrate the correct way of doing the work, a series of photographs were planned. These were to include:

1. A road condition showing loose material to be removed.
2. Removal of loose material.
3. Squaring the resulting hole and removing unsuitable base.
4. Tacking for the patch.
5. Laying a patch.
6. Rolling.
7. The finished patch, showing a dense mix blending in with the remaining surface.

A crew was organized and a road selected. At the particular time of the year, the only road left in an unpatched condition was a minor secondary road which needed complete reconstruction. The first decision required was to select a portion of the road illustrative of conditions more likely to be encountered. The subject matter specialist was the only qualified man to do this.

Once material was being removed, the question arose of when to stop removing old surface. A rule of thumb was developed and illustrated which stated that, "As long as material can be removed by gentle action of a pick/mattock, it should be removed. If it is stuck down tightly, leave it there."

A tack of 0.05 to 0.10 gallon per square yard was desired. The tack which resulted after careful discussion with the operator was about 0.40 gallon per square yard, the least he could practically obtain.

The remainder of the illustration process went smoothly, but this crew was the fourth such crew — the first specifically organized — that had been photographed before all things were suitable for illustrative material.

The example is an indication of the nature of developing materials. The conclusions to be drawn are:

1. Close cooperation is required between the subject and training personnel to ensure correct performance is illustrated and that it is well illustrated.
2. There must be the ability to control the performance of a crew being used as illustration. A training man cannot count on obtaining good illustrations by observing crews working in their normal manner.
3. The photographs — or other illustrations — must be carefully planned to ensure that all are taken when there is opportunity.
4. Many illustrations are required and should be anticipated.

Basic Material

As task oriented materials are prepared, it is necessary to supplement the specific information with sufficient background data to ensure understanding. The workmanship aspects of patching again provide the example.

Techniques for describing how to obtain and identify a proper application of asphalt were developed. One of the reasons for developing the training material was to prevent patches with too much asphalt — fat patches. The basic information describing a fat patch and its causes was required before it could be expected that operators would try to get correct applications.

Guiding the development of basic materials was the observation that maintenance employees did not generally understand why a patch which looked good when placed should with time turn into a fat patch. Their general assumption seemed to be that the rock had stripped off, leaving the asphalt without cover material. Observation and review of literature available indicated that the problem was not of

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retaining cover stone, but was instead asphalt flowing over the stone once traffic action had compacted the cover material. In nearly every instance, the first layer of stone had been retained.

Training materials were developed illustrating the mechanical action of traffic on cover aggregate and the volumetric relationship of asphalt and cover stone. Further, it was noted that the relationship could be broadly described to the maintenance employee by telling him how far the asphalt should come up after traffic had flattened down all of the pieces of stone.

Materials related to the basic KSA's were prepared as needed in the materials developed by the project. It is the general conclusion that these are in many cases more easily developed in this way — with the exception of those like basic mathematics — and that these data will provide the basis for developmental materials in the future when organized on a subject matter basis rather than the currently used task organization.

TRAINING METHODOLOGY

The project established training methodology and developed materials based on its being used by line supervisors as a part of their regular control responsibility. The considerations and the techniques used are described in this section.

Of importance in the selection of media are the basic characteristics of the training situation. The primary considerations in maintenance are the geographic dispersion of the training population, and the generally low level of verbal and computational skills — true of both instructors and trainees in many cases. The geographic dispersion of personnel suggests use of media that can be cheaply produced and widely distributed while the levels of verbal and computational skill suggest materials that are virtually self teaching. Combined, these two considerations indicate need to exercise care in isolating the specific items of knowledge, skill and ability required to effect performance improvements.

While these considerations are of primary importance in the selection of a training method, there are others which are important to both the selection of media and actual development of materials. Training, in many cases, attempts to fill more than one objective. Being problem oriented it has to be effective in communicating to the specific people who are causing the performance problem. In this respect it has to be directed to the least apt trainee rather than the man of average ability. On the other hand, the same training must in most cases provide a body of material that is effective in the development of those who show potential for advancement. Furthermore, since it contains performance oriented information often available from no other published source, a distinct advantage lies in having it available for quick reference at the operating level.

Selection of Training Methods

It was recognized by the project staff that different methods of training have different end results in terms of their effectiveness in communicating information. However, for pilot testing the specific training needed in maintenance at this time, there were only a relatively few methods that satisfied all requirements. For use on the project, the materials had to:

1. Be suited for wide distribution with minimum cost.
2. Be suited for use by line personnel in conducting the training.
3. Require only a short time to produce.
4. Require no pre-commitment to training equipment.
5. Be easy to modify as a result of trial and evaluation.

To satisfy the above requirements plus the organizational considerations, the project selected three techniques for use dependent upon the nature of content and the persons to be trained. These were: (1) training guides, (2) flip charts, and (3) conference materials. Each is discussed below, and examples are shown in Appendix C.

Training Guides

A training guide is a highly illustrated booklet dealing with a limited subject. It is organized with the text on the left hand page, and illustrations or outline of key concepts on the right hand page. In this way, it is useful as reference material, can be used to instruct a large group when further illustrated by slides or overhead projector materials, can be used directly as a flip chart with small groups, and can be used on the job for reference and to illustrate the correct way to perform work.

Flip Charts

A flip chart is a sequenced and highly illustrated presentation with essentially one thought to a page. The instructor can obtain reasonably good results by reading each page without additional comment. However, supplementary discussion is generally used and increases the effectiveness of the presentation.

A flip chart is a convenient training method when only one topic is involved, and lends itself well to use with operators at the area level. It can be published in book form similar to a training guide for use with smaller groups and for reference.

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Conference Materials

In many subjects, where the personnel to be trained or the training content is such that an instructor is dictated, a class room or conference approach was adopted. In these cases, text material, conference leader's guides and appropriate case and illustrative handout materials were prepared.

The selection of training methods is primarily the responsibility of the training specialists. However, the same cooperative effort between training and subject matter specialists, as was necessary in early phases, is also called for in this activity.

DEVELOPING MATERIALS

A major step in developing materials has been discussed in the development of illustrations. The other areas are the actual writing of text and the production of the materials themselves.

The original writing of the text should be done by subject matter specialists. Then the training specialist must take the materials and rewrite them in a form suitable for use in training. The establishment of logical patterns of thought, illustration, summarization and repetition of major points should be left to the training specialist. It is his responsibility to know the terms needing definition, mathematical abilities of trainees and other factors affecting the resulting materials.

The training section will be in position to make arrangements for reproduction and drafting services. This and final editing are areas where the training specialists can add considerably to the effectiveness of resulting materials.

Chapter ELEVEN

UTILIZATION OF TRAINING MATERIALS

Associated with the development of materials, the project staff analyzed the utilization of training materials and their influence on work performance. This chapter presents the results of this review. The following sections contain

1. General conclusions related to the use of performance-oriented training materials.
2. Utilization of specific types of training materials.
3. Criteria for evaluating training effectiveness.

GENERAL CONCLUSIONS

Training of the type presented is designed to complement other management activity. In this sense, it is necessary that the greater part of the training be conducted by the same people who are responsible for performance, and that the training be done as a part of the regular working day of the men performing maintenance operations. Under the conditions present in maintenance, it is not practical to depend on personal whose sole responsibility is that of an instructor.

Within this context of direct and regular line involvement in training as a part of day to day management effort to improve performance, several general conclusions are pertinent. These are:

1. The results obtained from training in the maintenance area for some time to come will be due more to the fact that needed information in usable form is being provided for the first time than to the particular training technique used, or to the excel-

lence of presentation. Provided with illustrated materials, and properly briefed, most present line supervisors can communicate adequately the minimum body of information required to change performance. Provided with such needed practical information, most present field personnel (if properly motivated) are capable of putting it into effect.

2. Motivation to apply the information must derive from effective supervisor-subordinate relationships. The ideal instructor at each level of the organization is the well motivated and prepared immediate supervisor of the recipient of the training. Each instructor must in turn have been trained and motivated by the next higher management level.
3. Maintenance employees have difficulty with manipulation of numbers — particularly older employees. Under these circumstances, computational functions involved in doing the work must be simplified and highly proceduralized. As younger personnel move into the supervisory ranks this problem should lessen — particularly if instruction in basic mathematics is provided.
4. Far better participation is obtained where the training group is small and composed of persons familiar with each other. This provides the participant with a non-embarrassing situation in which to learn, and he is far more inclined to ask questions and discuss issues than when faced with the prospect of hearing the sound of his own voice in a room full of strangers. The conclusion is that, in general, residency level conferences for superintendents will be more effective than larger ones held at the district level. In the same way, area level meetings will be more effective for Foremen and operators than larger meetings at the residency office. This applies to nearly all types of training. Where a special instructor is required or highly sophisticated materials are used larger groups at central locations are appropriate.
5. It is extremely difficult for anyone to conduct adequate training using material someone else has written without having some advance preparation. It is extremely time consuming and difficult to attempt to write material that is suitable to be mailed out for use without such preparation, inasmuch as every possible question and discussion point must be anticipated and covered. In the interests of both the amount of training that can be developed and implemented and the success of that implemented, a systematic and thorough pretraining and preparation of instructors is imperative.

Utilization of Training Materials

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The concern for preparation of the instructor applies regardless of the level or degree of informality with which the training is to be conducted. Even a trained instructor benefits tremendously from prior conduct of or at least exposure to a segment of training — particularly where summarization of main points and discussion of questions are concerned. Therefore, as a general rule a sequence of meetings should be held to implement each training subject. These should start with a meeting of district personnel for the purpose of presentation of the material by a state level training specialist, either from the Maintenance or Personnel Division as may be appropriate for the subject matter. The district personnel, in turn, should hold district level meetings for residency personnel, and the residency personnel should present material to area personnel. Only in this way can the line organization hope adequately to convey the full intent and content of the training material.

FIELD USAGETraining Guides

The development of training guides as a format for presentation of subject matter was one of the more significant results of the research. They are designed specifically to fit the subject matter, the maintenance situation, and the basic approach to training.

Their intended role in achieving performance improvement is varied. In most cases the guide by itself is basically designed to serve as a complete training program and aid for distribution and discussion at residency level meetings of the Superintendents. At such meetings, the training would normally be conducted by the Residency Maintenance Supervisor, who has been previously trained using the same material.

Beyond the training of residency Supervisors and Superintendents, the guides are designed for end use in training Foremen and Operators at the area headquarters and on the job. Presumably, a Superintendent or Residency Supervisor who has been trained in a particular subject area will be able to pass along what he has learned using the right hand pages of the training guide as his basic aid. He may do this in different ways as follows:

- By holding informal conferences with individuals on specific points covered in the more formal training that relate to observed performance problems. Such conferences may be brief and held on the spot when the performance problem is observed.
- By reviewing the entire subject or a major segment of it with small groups at the Area headquarters as appropriate. The Residency Supervisor or Superintendent may wish to schedule and hold such reviews on a regular basis — for example, for one hour each Wednesday morning.

Beyond these obvious conventional training uses, training guides serve several other functions. These are:

1. They are used by the Superintendent for his own reference on practical and technical matters (such as which size crew to use),
2. They are suitable for use in providing local training on a "home study" basis for potential foremen (and for the superintendent himself).
3. They provide a basis for the production of more sophisticated materials such as slide presentations, motion pictures, and flip charts. Generally, such materials should not be developed without adequate trial first of the less formal approaches defined above — along with analysis of other factors that may be affecting performance.
4. They provide an excellent way of informing management of the specific content and points of emphasis that are to be made in each training subject area. Considering the fact that what is published as training material will be taken literally by most who receive it, such a detailed review by management is imperative.

The actual implementation of these materials should be guided by the following:

1. At the Residency Supervisor level advance reading of the guide followed by in-depth discussion of the main points of emphasis will usually be adequate. At this level a great deal of the explanatory material included in the guides is not really needed and serves primarily as a source of examples and ways of explaining the points made when the Residency Supervisor is called upon to discuss the material at lower levels. In most cases a single meeting at the District level conducted by the Assistant District Engineer for Maintenance, someone appointed by him, or a subject matter expert will suffice to prepare the Residency Supervisors for further distribution of the information. Where possible, Resident Engineers also should be provided with copies of the material in advance and attend such meetings. Their active support of the ideas set forth in the materials is vital to actual accomplishment of the desired performance improvements.
2. The use of the training guides by Residency Supervisors in training Superintendents should vary from residency to residency. The degree to which a page by page as opposed to a selective discussion

approach is used depends on what the supervisor thinks is required to achieve the desired performance and development results among his particular group of individual Superintendents. He should not labor through a page by page discussion if he feels that he can better accomplish the job discussing only a few selected portions of the guide. The Superintendent will be provided with a copy of the material and will be in a position to read and review all of the material. Here again, advance distribution of the material for reading prior to discussion is advisable.

3. Conduct of training for persons below the Superintendent level using the training guide as the only training aid should also vary — primarily due to the varying ability of Superintendents to serve as instructors.

It appears that training at this level should be of three types: formal presentation of the material to Foremen and Operators at the area shop, informal discussion of specific points as indicated by observed need for specific performance improvements, and home study.

In the first instance it will probably be best for the Residency Supervisor to schedule and conduct the training — unless the Superintendent is obviously capable of making a good training presentation.

The second instance represents the envisaged role of the average Superintendent in the operations training process — primarily one of informal conduct of on-the-job coaching and training as called for by the situation. It is here that the many explanatory examples included in the materials should be of most value.

The final instance — home study and review — is, of course, an individual matter. Residency Supervisors and Superintendents may wish to schedule such review for all of their Foremen, and particularly those with potential for advancement. The value of this third type of use of the material should not be underestimated, particularly as it is the only type of technical development training available at this level at the present time.

Flip Charts

Flip charts provide the instructor with a practically self-teaching device. Presentation of the training requires little in the way of skill on the part of line instructors. Many segments of the training guides can easily be enlarged and converted to flip chart form if it is felt necessary to do so based on training results obtained.

In order to obtain some measure of the amount learned from the training presentation, interviews were conducted before training with nine operators

selected at random from the Richmond District — the pilot district for testing of the maintenance management system. The idea was to obtain some measure of knowledge levels before training. With only one exception — a man who had just come on the payroll — these operators already knew most of the essential information to be taught. Inasmuch as it was unlikely this could have been true without recent coaching, it was concluded that the Superintendents had managed — without the aid of any training materials — to pass along what they themselves had learned from the occasional informal exposure they received to the flip chart while it was being developed.

The conclusion was plain and highly significant that the problem had been one of motivating the Superintendents and supplying them with needed information. Beyond that point they demonstrated adequate capability to communicate effectively with their men. While the flip chart after it was distributed made this job of communicating with lower levels easier — particularly when the Residency Supervisor or Resident Engineer conducted the training — the fact that the Superintendent could be effective on his own if given the operating information he needs was clearly established. The fundamental conclusion was that many "training needs" represent primarily needs for development and distribution of practical performance oriented information rather than specifically needs for training.

The overall conclusion drawn from the pilot testing of this type of material was that flip charts could be highly effective tools for use by the line organization. They seem suitable for use in passing along information to Foremen and Operators on specific phases of operations which these persons directly affect. In such cases they may often represent material supplementary to that contained in training guides and/or in written policies and standards. They are particularly suitable for fulfilling recurring widespread needs — such as those related to drivers of snow removal equipment as in the case pilot tested under the project. Interviews conducted from one week to as much as one month after the pilot training had been conducted revealed an average retention of about 90% of the important information intended to be communicated.

The considerations in the actual use of flip charts are similar to those for training guides — level by level introduction and discussion of the material again being highly desirable. The success of the presentation at the primary level — the level at which the training is primarily aimed — will depend upon:

1. The degree to which the material itself contains information needed to obtain performance in terms and context suitable to this primary level, and the degree to which the line instructor and the management hierarchy above him demonstrate support for the performance changes being promoted.
2. The degree to which the line instructor is able to make brief comments page by page as he proceeds without destroying the continuity of thought

flow basic to the flip chart type of presentation. This implies adequate knowledge of what is coming to defer questions that are premature, and makes adequate briefing of the instructor imperative.

Conferences

Conventional conference type training is called for particularly where judgment factors as opposed to procedural factors form the main points of the training. Here the leadership of the training is far more critical to success than in the other techniques, where, because of the extensive visual presentation of data, training may be successful even where the instructor is not skilled.

Where a subject expert and/or a skilled conference leader can be used to conduct conference type training, the materials themselves can be quickly prepared and need not be extensive. Many highly successful conferences will result from use of a simple one page outline of main points for discussion. This situation, however, due to time and expense factors, will generally be restricted to conferences held at the central office and/or district levels.

When conference type training is used at lower levels, using conference leaders from the district or residency staff, far more effort must be expended both in the preparation of the materials and of the conference leaders themselves. Materials for use at these levels must be highly proceduralized with clear complete instructions to the conference leader. Pilot testing to determine probable questions arising in the discussion and problems in explaining points of training emphasis are highly desirable if not critical to training success. The result of such pilot testing performed by trained leaders should be revision of draft conference leader's guides to include:

1. Clarification of procedural instructions to the conference leader where needed.
2. Notes to the leader regarding probable questions that will arise and how he should handle them.
3. Amplification of explanatory material, blackboard examples, etc. found to be successful in obtaining desired response from trainees.

The conduct of the conference type training at each level of the organization then — along with those improvements introduced as a result of pilot testing — should do much to assure that conference leaders at the lowest level at which the training is conducted will have a good chance of success. Without such a sequence of pilot testing and successive conduct at each organizational level, conference type training in the residency is not likely to produce performance change.

EVALUATING TRAINING EFFECTIVENESS

Training is intended to improve work performance. Therefore, training effectiveness can be evaluated only in terms of performance improvement. These statements are the key to the performance orientation to training which was established for this project.

There is need to evaluate training on both a short term and on a long range basis. Though the eventual worth is the savings which result, there are other factors which must be considered. Training will often result in reactions in areas other than covered by specific materials. Since savings and other effects cannot be measured at the time of training, this evaluation must be in terms of the reaction of the men being trained, and be judged as an anticipation of performance changes, and development of new personnel. The evaluation must include:

1. Determination of amount of learning and actual information gained.
2. Evaluation of the relationship of the information to the specific task.
3. Evaluation of the desire on the part of the trainee to use the information gained.
4. Evaluation of the degree of support gained among management and supervisory personnel for the specific concepts being presented.
5. Estimation of the ability of the training to accelerate the development of potential supervisors.

The preliminary evaluation must then be checked as a part of performance evaluation. Areas which do not show improvement may be the result of poor training, the training materials, or management factors other than training.

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**HANDBOOK ON TRAINING
FOR ROAD DEPARTMENTS**

By

Marlene Glassman

**NATIONAL ASSOCIATION OF COUNTY ENGINEERS
TRAINING GUIDE SERIES**

**National Association of Counties
Research Foundation**

1974

What It's All About

You — as head of a state, city, township or county road department — are responsible for your department's work. To assure the best results, you are always looking for ways to help everyone work together, be more cooperative and to increase productivity and efficiency.

One way you can improve your operation is to train your employees. Since your department's success depends a great deal upon your crews and how they perform their jobs, training for crews and crew foremen is especially important.

The purpose of this handbook is to give you information you can use to train foremen and crews, including information about training material already available and appropriate for your department.

You can discuss this handbook during department meetings and during special meetings on training. Perhaps you can encourage your state association of counties or county engineers to sponsor training workshops, using this handbook as a resource.

The *Trainer's Guide*, the booklet which accompanies this handbook, provides information to guide the person who will train your foremen and crews.

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Why Training?

Training is really nothing new to you. When you orient new employees or explain department policies and procedures, you are conducting a kind of training program. This handbook focuses on more structured training as skills development for your crews.

Training has many benefits for your department's work and workers. It can reduce costs; help you adapt to change and cope with manpower shortages; improve your employees' morale, your safety practices and ability to respond to emergencies.

REDUCE COSTS

To a great extent, the effectiveness and the cost of your department's operation depend upon your crews. Are you operating as efficiently and productively as you could? Are crews using the best methods and right equipment to do their work?

Crews, for example, when blading aggregate surfaces, may be unnecessarily reshaping the road surface in dry weather. With proper training, foremen and crews would learn to reshape only under proper conditions, when the aggregate is moist or wet.

Snow plow operators may be using only salt for ice control when temperatures are too low for salt alone to work properly. Training would teach operators how to use salt and other additives, such as calcium chloride, so that ice control conforms to the current and expected temperature level.

The *Handbook on Training for Road Departments* is part of the NACE *Training Guide Series*. The *Trainer's Guide*, accompanying the handbook, provides information to help the person who will train your foremen and crews. Five guides cover the subjects: *Blading Aggregate Surfaces*, *How to Talk and Communicate at the Same Time*, *Improving Traffic Maintenance*, *Maintaining Bridges After Inspection*, *Tips for Conserving the Environment and Energy*. Appendix A describes each guide; the last page of this handbook provides ordering information.

Training saves money for the department by decreasing the number of mistakes made and by improving the quality of a crew's work.

Crew time, materials and equipment used to produce a faulty or deficient job are wasted. Mistakes must be corrected, and corrections cost additional crew time and equipment and material use — which all cost money, for the department, the county and the taxpaying public.

VOUCHER	
ITEM	AMOUNT
extra materials:	\$
overtime	\$
TOTAL:	\$55

Training standardizes and improves work quality among all crews in the department. Improved work quality on a construction project, for example, results in reduced future maintenance costs.

Training increases productivity as well as efficiency. An increase in productivity saves the department money. For example, if more miles of road can be bladed properly, the department gets more work accomplished.

INCREASE ABILITY TO ADAPT TO CHANGE

Many influences may require changes in your practices: new technology, materials, and equipment; changes in standards, policies and legislation; budget changes; and social and political concerns.

Progress Report*	
18 miles	graded
*Before Training	

Progress report*	
25 miles	graded
*After Training	

Training can help you implement necessary technological changes. Workers can learn how to operate new equipment efficiently and safely and how to work properly with new and different materials.

Crews, through training, can learn how to meet required standards — which may change because of federal guidelines and/or state law.

Change in your budget allocation will affect your crews' work loads. If you get less money than you had in the past or are expected to perform more work with the same amount of dollars, training can help. For example, the blading crew might have to do the work of the painting and striping crew and with proper training could acquire needed skills.

Increasing social and political concerns are affecting your operation and the need for training. The energy shortage is an example. To conserve fuel, foremen, for example, could be trained in quick check procedures to save vehicle trips by regular job inspectors.

Another concern affecting your activities is the need to protect the environment. Through training, crews can be shown specific ways to reduce pollution; for example, disposing of solid waste materials from a completed job in an authorized sanitary landfill rather than dumping waste in a hidden washout.

IMPROVE ABILITY TO COPE WITH MANPOWER SHORTAGES

By training one crew to assume the work of another (cross training), you can reduce problems created by shortages of manpower, including shortages created by vacations and illnesses. Cross training also helps you fill vacancies when employees retire or otherwise leave the department.



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Be sure to investigate union and employee bargaining constraints before cross training your crews.

IMPROVE EMPLOYEE MORALE

Training can also improve employee morale. Workers who know they can do a job well will feel more confident about their abilities and, thus, better about the work they do.

By giving employees the opportunity to advance in the department, training can improve morale. If employees take part in training that qualifies them for promotions when vacancies occur, they are more apt to stay with the department. Turnover in employees (which is costly) will be reduced, but when vacancies do occur, a department with a training program tends to attract new employees.

Training brings people together. Group training can help improve relationships as employees work together toward a common goal. They may renew old friendships and create new ones. Understanding among individual crew members, between a crew member and his foreman, and between the foreman and his entire crew may improve. If you are directly involved in training a crew, you have a good opportunity to get to know your crew members: to learn about their abilities, problems and interests. Likewise, crews can become better acquainted with you.



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Training gives employees a chance to exchange views and make a contribution to work policies and other decisions that

affect them. An employee asked for his ideas will feel he is an asset to the department, and indeed — he may become a greater asset. It is vital for each person to feel he is a part of the department and is free to express his ideas and to make suggestions. This applies to crew-foremen relationships as well as foremen-department head relationships.

INCREASE SAFETY AND ABILITY TO RESPOND TO EMERGENCIES

Safety is important for the public and employees, especially for those crews working on the road with complex machinery. Safety principles and practices can be effectively communicated through training. Actual demonstrations can show required practices. For example, training can show a flagman how to safely and effectively control traffic in a barricaded area.

Proper training can prepare crews to respond to emergency situations, such as natural disasters, fires and blizzards. Because of the unpredictable timing of an emergency, advance planning is imperative, and crews must be prepared.

IMPROVE RELATIONS WITH THE PUBLIC

Training can help improve the department's relations with the public. How employees communicate with the public and how employees handle complaints from the public are two important areas that can always be improved.

Most of the examples used above and in the rest of this handbook relate to points covered in the NACE Training Guide Series. See Appendix A for a description of each guide.



Getting Ready For Training

Before you start training your crews, you need to determine your training needs and whom to train. When we say *you*, it may be you personally, your personnel director, superintendent, inspector, or foreman.

DETERMINE TRAINING NEEDS

First, you must consider:

- Kinds of work that must be done
- Time frames for completing work
- Number of employees needed to do a particular kind of work
- Skills your employees possess

How do these considerations affect the work of your crews? All the considerations work together; if you do not have enough people or people with the right skills to complete a particular job within a specific time frame, training is needed. As mentioned earlier, cross training one crew to acquire skills for performing other kinds of work is helpful if you don't have enough crew members for a job. For example, if you contract weed spraying and are short of snow plow operators, you could train a crew to spray weeds and operate plows.

Following are some ways to check on your training needs:

- Compare schedules, plans, and work programs with records of actual work being accomplished. When there is a definite difference between your plan and what is actually done, training may be needed. For example, if your blading schedule calls for an average of 25 miles of road to be bladed per week, and only 18 miles are bladed, you may need to increase the productivity of your crew by starting a training program
- Assess not only the quantity but also the quality of your crews' work. You can tell whether crews are producing quality work
- Analyze equipment life to indicate need for equipment operator training. A roadside mower showing wear and tear exceeding normal use could indicate your mower operator needs training
- Consider use of new types of equipment and materials that may necessitate training
- Consider employee turnover. High rates of turnover might indicate problems that training could help ease. You can also provide training for normal attrition — when employees retire, finish school, or move out of the area
- Get training suggestions from your crew foremen since they are in daily contact with crews and have first-hand knowledge of problem areas
- Consult crews for their suggestions on their training needs

Encourage your foremen and crews to suggest training they would like to receive. Working together to determine training needs is a type of training in itself. Listen to and seriously consider employee suggestions. Remember that employees

are more apt to accept a decision they help make rather than a decision imposed upon them.



DETERMINE WHOM TO TRAIN

It is important that you know your crews and their individual and group needs before you decide upon persons to include in a training program.

You should know the particular abilities of individual crew members. For example, a mechanically-oriented, competent dragline operator may not necessarily be the right individual to train to become an inspector.

You should also know your crew members' personalities. A welder, for example, may possess the skills to do superior welding work, but does he possess the "personality" and leadership capabilities to be a foreman:



- Does he get along well with others?
- Could he guide others?
- Could he give instructions and explain procedures clearly?

Determining whom to place in a training program that develops supervisory skills is a difficult but important decision.

Not all employees want higher level jobs. Try to determine who these employees are before training participants are

selected. If you think an individual has potential for a higher level or different job, and he is reluctant to try for it, you can let him assume the job on a trial basis. It may turn out he likes the job and that he can do it after receiving training. However, if he only lacks confidence, he stands a better chance of gaining it through training rather than risking failure trying to do the job untrained.

To help you select persons to receive training, consider problem areas. For example, members of one crew may complain because their work load is usually heavier than another crew's. Required to work hard, the first crew may see that a second crew has little to do. (There may be good reasons for work load differences; e.g., type of work, terrain of job site, local difficulties, etc.) One solution, if work is compatible, is to provide some cross training for the second crew so it can assist the first when feasible.

Bridge problems can indicate that road crews need training to encourage them to look at more than road surfacing on bridge decks. (See NACE Training Guide, *Maintaining Bridges After Inspection*.*)

DETERMINE PRIORITIES

After you have determined training needs and individuals to be trained, decide on training priorities.

To determine priorities, consult superintendents and foremen. Consider the department's areas of *greatest* training need. But always list *all* needs. You may find that some

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training needs can be met without great expenditures of time and money. Training for such needs can be accomplished with a minimum of effort and without interfering with your priorities.

Some of your fellow county engineers suggest the following areas as training priorities:

- Safety and first aid practices
- Public relations
- Heavy equipment operation and maintenance
- Areas of major expense in dollars and manhours, e.g., asphalt resealing and patching
- Work requiring new types of equipment and/or materials requiring new methods of application

Time and money will, of course, influence your choice of training programs. You can implement only those programs you can afford. You must weigh the time involved in setting up and running training against the time employees need on the job.

The Economics Of Training

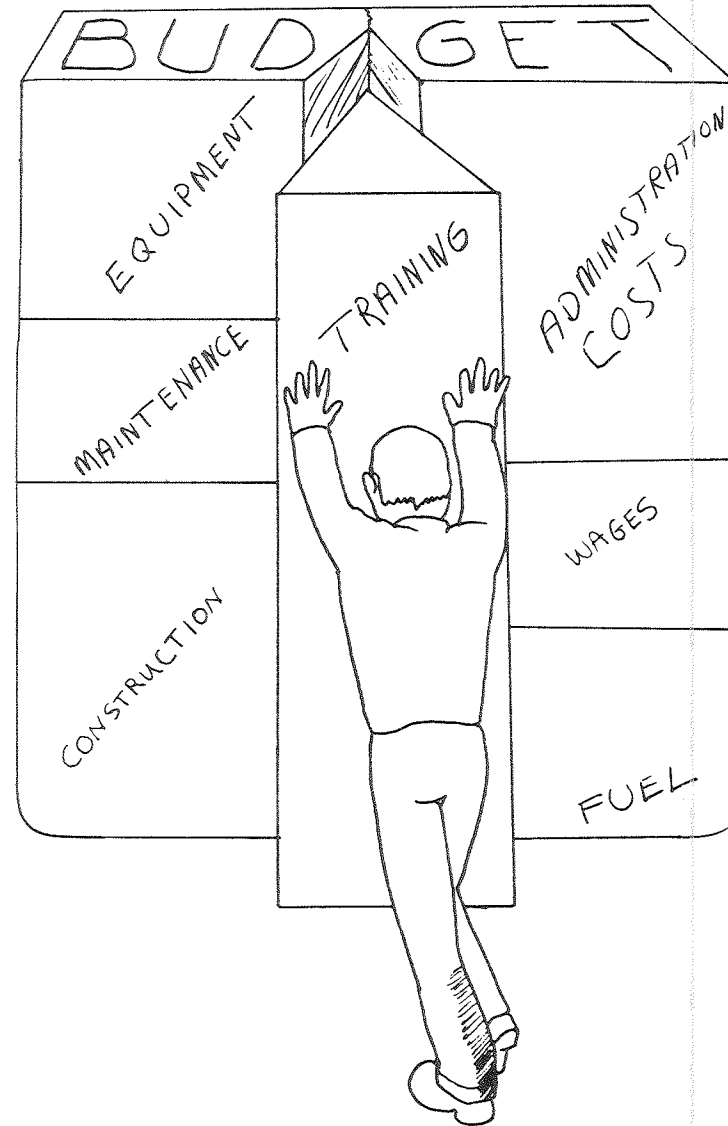
An important consideration in developing your program is the economics, especially the cost, of training. The kind of training conducted, length of course, and number of persons influence cost. Each of these influences can be adjusted to accommodate your budget. (See page 35 for information on adjusting training time and audience size.)

You can save money by adapting training resources; by developing your own trainers and your own training programs (see pages 32-37) and by making use of your county's training director or office, if there is one.

If you use the *Trainer's Guide* to help train your foremen, for example, and if you use the *NACE Training Guide Series*, training will cost you only your trainees' time, (equipment costs, if any) and any costs for buying training materials, such as additional copies of NACE training guides.*

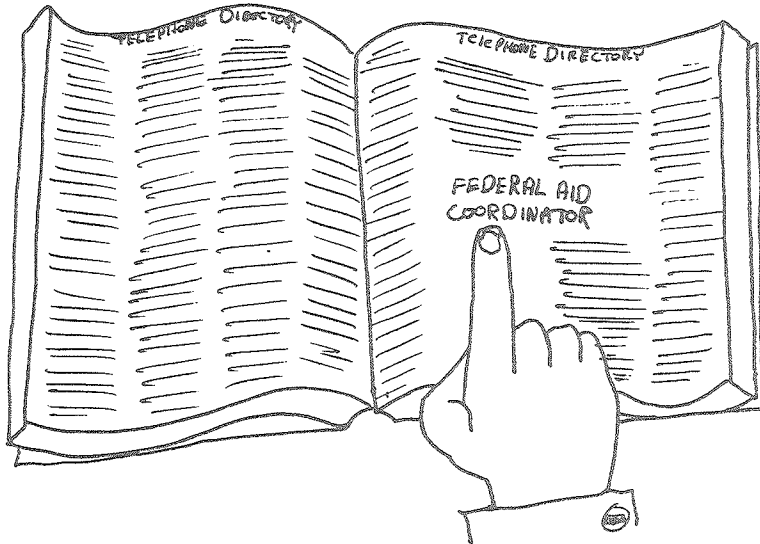
Some training may be free. Check programs of your local community college and vocational-technical schools as well as local high school adult evening classes; safety training by the American Red Cross and insurance companies; training provided by manufacturers and material suppliers (see Other Ways To Provide Training, pages 41-48).

*To get copies of NACE Training Guides, see order form, last page of this guide.



Regional programs with other counties and jurisdictions can save you money because it allows you to pool and share resources — men, materials, money.

Some state and federal money is available for training. Congress, through various acts, appropriates money for training purposes and apportions this money to states. Training money may be available from legislation other than transportation legislation — legislation relating to manpower and education. To find out what money may be available, check with your state highway department's secondary roads engineer, your state's training officer, and your county federal-aid coordinator, if your county has one (this person may be called an intergovernmental-aid coordinator, a county development coordinator, etc.).



You may want to persuade your Board of County Commissioners to make training a line item in the county's budget. You yourself can make training an item in the road department's budget.

Scheduling Training

TIME	SCHEDULE
	FUNCTION
10:00 AM	Blanch on R/S 567
11:00 AM	Confer for...
1:00 PM	<u>TRAINING</u>
2:00 PM	...
3:00 PM	...

PART OF YOUR DEPARTMENT PROGRAM

Assuming you have decided on training needs and priorities, the next step is scheduling.

In spite of existing schedules, training is important enough to warrant time of its own. You should develop schedules so that you do allow specific time for some crew training. Remember, in your scheduling, that training is not a one-time session, but a continuous process. Training needs to be a continuous process because of loss of personnel by attrition, changes brought about by promotions, and because of developments that necessitate training. Training should be made a part of the department's program and scheduled from year to year.

When scheduling training, check carefully for union and employee bargaining constraints that could affect the training schedule.

Although your present schedule may limit the time crews have available for training, it should be possible to meet your training needs and accommodate your schedule.

Consider the following additional factors in scheduling:

PLACE OF TRAINING

Training may take place within or outside your department. You will have to make plans accordingly. If a crew member has to leave his work to attend a training program conducted by a vocational-technical school, for example, you need to make arrangements for his job to be carried on by someone else during his absence.

Depending upon the topic, some training can be scheduled for department meetings. For example, you can conduct a training session on the NACE Training Guide, *How to Talk and Communicate at the Same Time*, at a tool box session or a general meeting.*

Remember that on-the-job training allows crews to learn while performing their jobs.

SCHEDULE DELAYS

If your work is delayed because needed materials, tools, and equipment are not available and the delay is somewhat lengthy, use the time for training. You will need to have a tentative plan so your foreman can make best use of the time; for example, if a crew is working at a bridge site and is delayed, bridge cleaning and painting could be discussed. (See NACE Training Guide, *Maintaining Bridges After Inspection*.*)

JOBS PERFORMED ON A SEASONAL BASIS

Much of your work is performed on a seasonal basis. Most of your fellow county road heads agree that training for

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seasonal work should take place immediately prior to the start of the season. For example, snow removal crews should be trained during the fall.

One county road head suggests these examples for training:

- During winter:
 - Equipment maintenance
 - First aid courses
 - Record keeping
 - Welding schools
 - Management courses for foremen
- During summer:
 - Equipment operation
 - Blading techniques, such as proper amount of crown and superelevation on curves
- During spring:
 - Roadside improvement
 - Seeding, mulching, fertilizer use, planting

WEATHER CONDITIONS

Unfavorable weather can provide time for training. If a crew cannot work at the job site because of bad weather, use crew time for training in the garage or office. For example, you could train crews on techniques of culvert replacement on a rainy day and the actual replacement on a short portion of a day when it is too late for crews to start another job. In other words, make good use of downtime by using it for training.

ADVICE FROM FOREMEN

For all training plans, consult your foremen. Since they are in daily contact with crews, they can advise on appropriate

times to schedule training. For example, they will know when a crew is ahead of schedule and when slack time is available for training.

EQUIPMENT NEEDS

Equipment needs will influence the scheduling of equipment operator training. For instance, when a backhoe is not heavily in demand during winter, train then. Some jobs only require a few hours of equipment use — idle time can be used for training.

KIND OF TRAINING

Your scheduling will be influenced by the kind of training to be conducted. A discussion of the different kinds of training that exist is found in the following section.

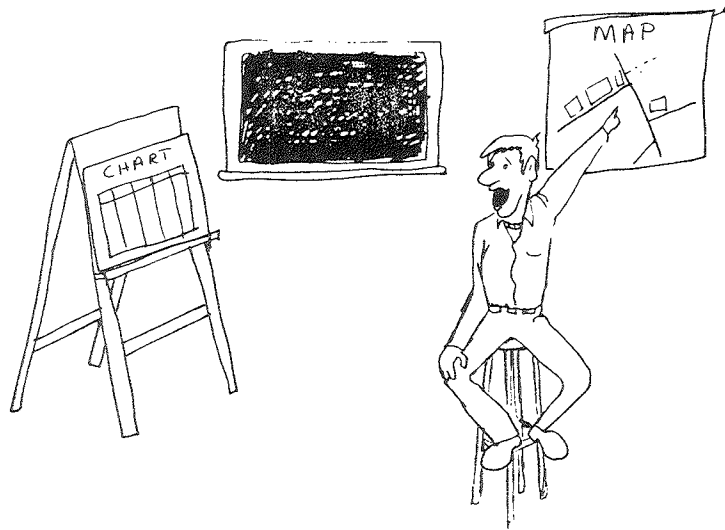
Kinds Of Training

Basically, crew training should develop skills to do a job. Training can be directed to an individual or a group and can be written or verbal.

Written forms include manuals, handbooks and guides. These are often directed to individuals who can develop work skills by reading and following instructions. An individual can learn from a self-instructional training manual which contains exams or questions for him to use to check his training progress. Written forms of training can also be used to train groups as well as individuals.

Training can be verbally communicated to a group by an instructor, or trainer. The trainer can train in a classroom or garage, by leading a discussion and by using training aids, such as slides, movies,





maps, charts, diagrams. In addition to training in a classroom-type situation, the trainer can work with a group at its job site, as the group does its work. This method is called on-the-job training (OJT).

Demonstration is an important part of both OJT and classroom training. For example, a trainer can show, as part of OJT, how to dump a load of material from a dumptruck; in the garage or in the field, he can demonstrate how to blend materials to achieve a proper mix for asphalt patching.

A trainer does not always work just with groups: he can work on a one-to-one basis with an individual; for example, riding on a front end loader with the operator.

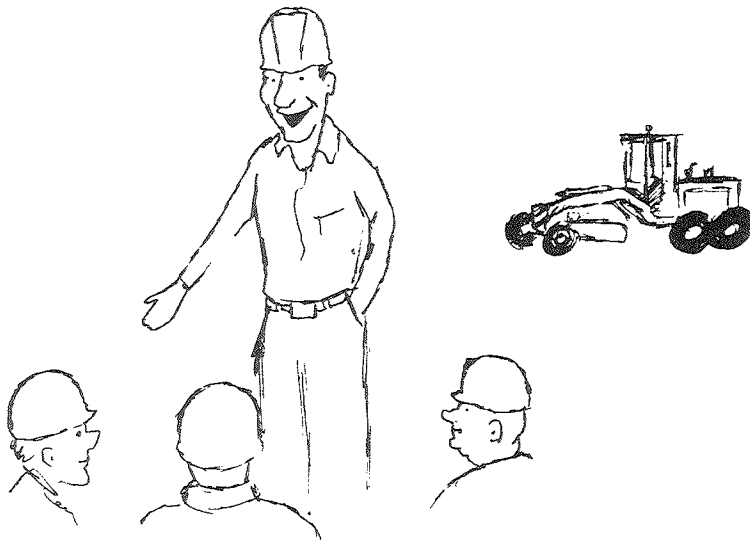
The best training method to use (considering cost and time) is determined by:

- The people to be trained — a group or an individual
- Trainees' existing skills and capabilities
- Kind of skill to be developed

WHICH TRAINING TO USE, WHEN?

How do you know what kind of training to use, and when? What do you want the training to accomplish?

Generally, your training objectives determine the best training method to use. On-the-job training is especially appropriate when training a person to operate a piece of equipment and when you want to demonstrate how something should be done, using materials and tools. Classroom-garage training, supplemented by training aids, is effective in communicating principles: the "what it is," "why we do it" as well as the "how to do it."



Written forms of training are useful for those accustomed to working with written materials. Verbal training is useful for training groups and those individuals not accustomed to reading instructions.

First consider whether you want to train a group or an individual. Do you have just one individual who needs to learn how to operate a backhoe, or do you have five laborers who need to learn about pothole patching?

Let's take blading as an example.

Suppose you have your aggregate surfaced roads divided into four districts: A, B, C and D. You know there is a problem with districts A, B and C because their roads are still rough after being bladed; whereas, the roads in district D are sufficiently smooth after blading. (See NACE Training Guide, *Blading Aggregate Surfaces*.*)

Now try to find the cause of the problem. One reason can be because the motor grader operators in districts A, B and C are not putting in enough hours blading when road conditions are right. Perhaps they don't know the principles of blading — what the blading job actually means. Perhaps there is a morale problem.

After discussing the situation with your three grader operators and their foremen; you may determine that each needs to learn how to better operate his grader. (If each district, A, B, C and D, has a different foreman, the problem could be that the foremen in districts A, B, and C are not good "supervisors" and and poor "trainers" — they do not communicate and explain well. If so, these foremen need

*To get copies of NACE Training Guides, see order form, last page of this guide.

training to develop supervisory skills and the ability to communicate.)

This hypothetical problem, then, involves three motor grader operators who can be treated as three individuals or as one group. Before you decide whether to train the three individually or as a group — in addition to considering training time involved and each man's work load — you must assess the three men involved.

You know that the motor grader operator from district A is an especially bright guy who reads a lot and who can figure things out for himself. He may need only read a handbook. The two remaining operators may be more verbally-oriented. They do not read often and do not understand diagrams easily. These two would benefit most from on-the-job training. Such training is more appropriate than classroom-garage training in this situation. The operators could work directly on the grader rather than with illustrations and diagrams.

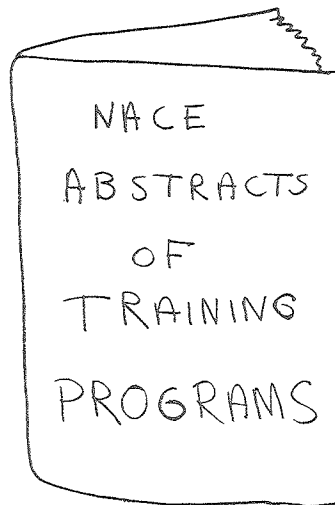
Classroom-garage training would be more appropriate if the motor grader operators needed training in how to keep their records. A trainer could effectively explain what maintenance records are, using illustrations or handouts.

Can You Adapt Other Training?

Because of differences in training needs and local conditions, it may be difficult for you to use training materials "as is." Therefore, it is important to discuss how to adapt training.

In order to assist you, in the fall of 1973, we made a nationwide inventory of training programs and materials appropriate for county road departments. We contacted state and local highway departments, educational institutions and other agencies. The results of that inventory are found in Appendix B, *Abstracts Of Training Materials Appropriate For County Road Departments*. The abstracts describe two categories of materials useful for training. The first category includes *developed training programs* you can use with little change. The second category includes *training resources* you can adapt for training.

In order to help you choose the best kind of training for your needs, following are some tips about (1) deciding whether training programs already developed are useable and (2) how to adapt resources for training (materials that must be changed before they can be used).



HOW CAN YOU DETERMINE IF A PROGRAM WILL MEET YOUR TRAINING NEEDS?

Some training programs already developed may not be appropriate for your training needs. Often a trainer's (instructor's) guide, curriculum, or course outline accompanies a developed training program. Check this material and the program itself for appropriateness. The information may be too advanced for the group you want trained. This may be the case, for example, when looking at some state highway department training programs. These training programs may apply to high-speed, high-volume roads; you may be more concerned about training for crews working on low-speed, low-volume roads.

Use your criteria, based on your specific problems (also see section below), to determine if a developed training program will meet your training needs. If you decide that a training program is valuable, but not totally applicable, you can adapt it.

HOW CAN YOU ADAPT A TRAINING PROGRAM?

To help you adapt a training program, consider the following factors (these factors can help you determine if a developed training program will meet your needs and can help you check on a program you have developed from another source).

Content Of Program

The program's content may be too complex for the group to be trained. You may be able to alter the high level of the content by reorganizing and eliminating material.

For example, the written style may be too complex. Substitute simple words for more complex ones, making sure you do not change the meaning of the idea. The words you use as substitutes should be words with which your crews are familiar. Technical terms also can be reworded so that they are more easily understood, but be sure to call attention to technical terms and to define them. For example, when training a crew blading a curved road, you can say, "On curved roads, the outside edge of the road is made higher than the inside edge. This banking of the curved part of the road is called superelevation."

You can clarify technical points by adding examples and illustrations and by using films. If you think the training program is too detailed for your purposes, cut out unnecessary material.

Information should be organized in a step-by-step manner, both in order of presentation and degree of complexity.

- The order of presentation should be logical
- Use chronological order when describing procedures and address one point at a time
- The information should clearly relate to the topic being discussed

In other words, make sure your material sticks to the point! Reorganize material so that you progress in detail and complexity from simple to more complex.

Adjust Program To Trainees

Although training is directed to a specific audience, you can use the same training for another audience. For example, you may think that a particular construction training program

directed to crew foremen is at too high a level for your crew foremen, but at the appropriate level for your construction inspectors. Use this program for your inspectors, but remember that the training must cover the work your inspectors perform.

Size Of Audience And Training Time Required

A training program will often specify audience size. You may want to use a bridge maintenance training program, for example, which is aimed at an audience of 12 trainees, and there may be 25 persons you want to train. You could divide the 25 individuals into two groups, of 12 and 13 each, and schedule the training in concurrent sessions or at separate times. Although aimed at an audience of 12, you could use the program for your 25, but realize that the benefits of "small group" participation in questions and comments will be reduced.

This same bridge maintenance program may require 40 hours in time per trainee. If your schedule does not permit this much time for training, you can consolidate the information. Carefully eliminate some material, making sure the program still retains necessary basic information. Or, you could schedule the training in such a way that the 40 hours of an employee's time are distributed over a long period of time; you could split the total training program into four segments, for example, with two-week breaks between segments.

Materials, Equipment And Facilities Required

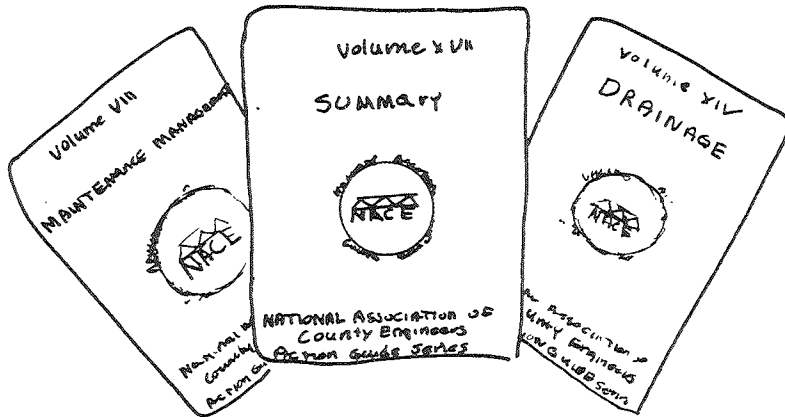
If you do not have the materials, equipment, and/or facilities for a specific training program, first see if you can "make do" without these requirements by adjusting the content that calls for a particular piece of equipment, for example. You may need to look for resources outside your department or your county, such as your state highway

department's shop. Information on the availability of "outside" resources appears on pages 41-48.

HOW DO YOU ADAPT A TRAINING RESOURCE?

The previous discussion was directed mainly to working with a training program someone else had prepared. There are other materials you can adapt for training. For example, written forms of training, primarily directed to an individual — as manuals, handbooks and guides — can be adapted for training groups. Portions of a textbook can be adapted for your training.

Appendix C shows how you can adapt a manual for group training use, i.e., for training one of your crews. The example uses a chapter in Volume VIII, *Maintenance Management*, of the NACE *Action Guide Series*.*



*There may be a copy in your county road office, or for ordering information, see order form, last page of this guide.

When adapting a training resource to train your crews, use some of the points already described.

Check to see if you:

- Address the proper audience: the information given to trainees should apply to their work
- Emphasize actions for the person who must perform the action
- Stress the "how to" and place the "how to's" in logical order from the beginning to the end of a process; for example, start your engine . . .
- Explain the "why" to back up the "how to"
- Localize general information so that it applies to your locality
- Use terms your trainees know
- Anticipate questions trainees may ask and answer them in the presentation
- Provide examples to support the information presented
- Use appropriate training aids (slides, maps, etc.) to help clarify the presentation
- Have questions to pose to trainees to start their questions

Getting The Training Done

It cannot be emphasized too strongly that there are many ways to get training programs started. Our search for developed training programs across the country uncovered many available resources. There are community colleges and vocational-technical schools. Institutes of local government, state highway department training departments and many others told us repeatedly that, although they might have no specific training programs for counties, training for county personnel could possibly be conducted if interest is expressed.

Contact some of the resources listed in this section to discuss your training needs and problems.

In many cases, you may have to choose someone already on your staff as a trainer for your crews. This may present some problems because that person does not necessarily know how to train.

This section provides some tips to help you get the training done, discussing potential trainers in your own department and then discussing outside resources.

TRAINERS IN YOUR OWN DEPARTMENT

Let's return to the blading example and the need for motor grader operator training, pages 30-31.

The grader operator in district D is blading roads properly: he is a good motor grader operator and a potential trainer for the other operators. Remember that his ability to operate a grader well does not assure that he has ability to train well. Again, you need to know the particular individual:

- His work background and prior training
- His personality: how he works with others; how others accept him; how others will accept him as a trainer
- His ability to teach others: to analyze situations; to explain
- His willingness to be a trainer



Apply these points when considering anyone as a potential trainer.

If this individual is willing and if you believe he has the capacity to train others to operate a motor grader, you can help him by providing him with training to develop training skills. (See accompanying *Trainer's Guide*.)

Foremen

A foreman is in a good position to be a trainer: he knows how to perform the work his crews do. In most instances, foremen have worked their way up "through the ranks." Because he already may be seen as a leader, crews are more apt to accept a foreman as their "teacher." In his supervisory position, the foreman is familiar with department policies and standards; he knows what crews *should* be doing. Since he is in daily contact with crews, he knows what they *are* doing. This contact enables him to know his crew members and their strengths and weaknesses. The foreman knows his crews' individual and group training needs, and he may often know how best to meet these needs.

Although your foremen are knowledgeable and skilled, they may need training to increase their skills, and they may need training to help them become effective trainers—to help them develop leadership skills and learn techniques for transmitting information.

Inspectors

Construction and maintenance inspectors are potential trainers. To perform his job properly, an inspector has to know what to expect from a project and the quality a project must achieve. He knows standards that workers must meet. He can readily distinguish between a quality job and a deficient one. By noting deficient work, the inspector can

recognize areas where training is needed. The inspector, like the foreman, is in a supervisory position and crews will generally accept him as a trainer. However, the inspector does not necessarily know how to train. Again, you must look at his personality and potential as a trainer and provide him with training skills.

Superintendents And Department Heads

If your department has superintendents, they are potential trainers.

And remember that you, the head of the department, can be a trainer, especially if your department is relatively small. And you, too, may be able to use some tips to help you become an effective trainer.

Training Office

You may be able to establish a training office, training director, or a full or part-time resident trainer for your department or county. If your county already has a training office or director, or a personnel director, try to work with that office to provide training for your department.

OTHER WAYS TO PROVIDE TRAINING

There are many ways to provide training. Training can be conducted in your own county and/or road department or outside of the county, at community colleges, universities, laboratories, research institutes.

NOTE: The deleted material applies to the U.S. only.

Evaluating Training

After you have completed any kind of training, it is worthwhile to consider what your training has accomplished. Although you cannot always precisely measure the results of training — the effect upon trainees and the operation of the road department as a whole — there are some indications when training has met its objectives.

Improvement in the following areas indicates accomplishment:

- Safety record: less accidents and job injuries
- Employee morale: reduced turnover and absentee rate; fewer grievances from employees; less resistance to change
- Productivity: increased results (e.g., more miles of improved blading); decreased road maintenance costs; reduction in overtime; improved equipment life; decreased number of lost tools
- Department's image: less complaints from the public; better acceptance; more compliments

To help evaluate training, you can interview or survey trainees. Ask for their comments at completion of the program and six months later, for example, to see if training has helped them. After you have received each set of comments, evaluate them and observe changes in performance.

Training that is part of a career development program may require a formal evaluation, such as testing, of each participant. For information on testing, you may want to consult *Total Job Training, A Manual for the Working Manager*, by Paul M. Stokes; American Management Association, 1966 — Chapter XII, "Measuring Learner Progress."

Keep a record of training program participants as a reference when considering promotions, transfers, how to accommodate manpower shortages, and employee reductions.

Recognize individuals who have participated in a training program by awarding a certificate, when appropriate.

Appendix C

How To Adapt A Training Resource

Training resources such as manuals, handbooks, and guides provide information that can be adapted for training. A good training resource is the 17-volume NACE *Action Guide Series* which provides management and technical information on 23 subjects. (For information on the NACE *Action Guide Series*, see order form, last page of this guide.)

The following example uses sections of Chapter 5, Volume VIII, *Maintenance Management*, of the NACE *Action Guide Series*. This volume is a guide for implementing a maintenance management system. The columns labeled "As Is" duplicate the words in *Maintenance Management*. The columns labeled "Reworded" show the same information in a training style.

Section 5.1.1, Responsible Supervisor

AS IS

Since the original maintenance work program was developed for individual area supervisors, the reporting must be by them.

REWORDED

We developed the original maintenance work program for individual area supervisors. Because you are an area supervisor, you must do the reporting.

Change the wording in a training resource from the 3rd person ("he," "she," "it," "they") to the "you" addressed in training. Remember, the person receiving the information must be the right "you."

It is important to use the active voice as often as possible: "you should blade;" as opposed to the passive voice: "blading should be done by the operator."

In training, you show the right action to do a job, so information should be communicated in terms of **action**. Good training emphasizes the hows, and training information should be written in a "how-to" style. When communicating in the "how-to" style, be sure to place the "how-to's" in a logical order. Often, this order will be chronological; that is, what to do first, followed by what to do second, etc. Good training supports the hows with whys. You should reword training resource information to emphasize why, as well as how, something should be done.

Section 5.1.4, Resources Used, first paragraph

AS IS

For performance evaluation, you need to know what resources have been used — manpower, equipment and materials. Provision for this reporting is included on the crew day card.

REWORDED

For performance evaluation, you need to know what resources have been used — manpower, equipment and materials. The crew day card contains room for reporting these resources.

During training, it would be good to actually point out to trainees the place where resource reporting appears on the crew day card. You could distribute a card to each trainee, or

you could make a slide of the card to project on a screen so everyone could see.

When adapting a training resource, determine what training aids or supplemental materials you could use to help clarify the information you present.

Section 5.1.4, Resources Used, second paragraph

AS IS

It is not necessary to identify individual employee names for reporting, as crew day cards are not generally used for payroll purposes. However, some counties record employee names each day to document work assignments. The required information simply is number of men and total man-hours or man-days (usually to the nearest four man-hours or one-half man-day).

You must apply the information presented to the situation in your county. If you require employee names to document work assignments, training must explain that this is the case.

If a training resource contains general information, make the general information specific enough to meet requirements

REWORDED

Our county requires a daily record of employee names so we can document work assignments. Therefore, when filling out the crew day card, list each crew member's name. Count the number of men who worked and enter the total number who worked in the appropriate blank. (During training, point out the appropriate blank.) Also include the total number of man-hours worked. You can round this number to the nearest four man-hours.

in your county or department. If alternative methods of performing an action are presented, you may need to select the one method that best meets your needs or the method that has been established for your department's use, and then train according to that particular method.

Section 5.1.4, Resources Used, third paragraph

AS IS

The use of specific pieces of equipment need not be reported unless you intend to use these reports for supplementary equipment management evaluation. Ordinarily, reporting by classes of equipment for determining equipment rental rates is adequate.

Again, you need to apply the information to your own situation. If, in your county or department, you do not use equipment reports for management evaluation, explain this during training.

When adapting resource information, be sure to explain unfamiliar terms in words with which your trainees are familiar. Also be sure to particularize general information by providing examples. For instance, if you mention "classes of equipment," give examples of different classes of equipment.

Section 5.1.4, Resources Used, fourth paragraph**AS IS**

Only the major materials used need to be reported — materials like premix, gravel, liquid bituminous materials, joint filler, etc. Insignificant items can be ignored.

REWORDED

Report on your crew day card only the major materials you use. Examples of major materials are premix, gravel, liquid bituminous materials, joint filler. You do not need to record insignificant items, such as nails, bolts, screws, survey stakes.

As you adapt resource material, check to see if the statements or instructions you prepare raise any questions. Do not make statements or give instructions that are not clear enough to stand on their own.

Anticipate what questions your presentation will raise, and answer them within your presentation. You can answer many anticipated questions by giving examples. For instance, if you make the statement, "insignificant items can be ignored," it is logical to anticipate that someone will ask, "what are insignificant items?" Therefore, you should state, "ignore insignificant items such as nails, bolts, screws, survey stakes."

This exercise provides an example of how to adapt a training resource and illustrates just some of the points to keep in mind. In essence, when you adapt a training resource, you convert the information into a presentation appropriate for your trainees and the particular situation in your agency.



Project Correspondent Nicholas J. Barber, Dean, Faculty of Engineering, Fourah Bay College, University of Sierra Leone.

TRAINER'S GUIDE

By

Marlene Glassman

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**NATIONAL ASSOCIATION OF COUNTY ENGINEERS
TRAINING GUIDE SERIES**

**National Association of Counties
Research Foundation**

1974

What It's All About

You perform a very important job when you train another individual or a group of individuals. This guide provides some tips to help you become an effective trainer. Tips cover:

- Planning for training: ON YOUR MARK
- Preparing for training: GET SET
- Performing training: GO

You can use these tips for training a group or an individual — at the job site, on a piece of equipment, in the classroom-garage and when passing information along to crews, such as information contained in the NACE *Training Guide Series*.

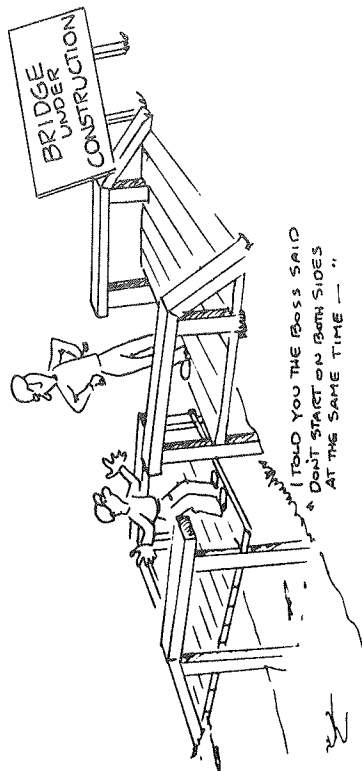
For related information to help you as a trainer, see the NACE Training Guide, *How to Talk and Communicate at the Same Time*.*

* *How to Talk and Communicate at the Same Time* is one guide in the NACE *Training Guide Series*. For information on the NACE *Training Guide Series*, see order form, last page of this guide and Appendix A of the *Handbook on Training for Road Departments*.

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On Your Mark

You must plan in advance! Advance planning is necessary whether you conduct only one training session or an entire training program. The information that follows can help you to plan an entire program as well as one training session as part of a whole program.

Figure out an overall plan for the whole training program before you conduct your first training session

Divide the program into individual sessions. Each session should logically follow the preceding session, building on information presented earlier. In training, you explain how to do something. Let your sessions follow the order of how that something should be done.

When possible, start with simple ideas and advance to more complex ones.

Decide how much information to present during the session

Remember that the head can absorb only what the seat can endure.

If the session is three hours long, for example, prepare enough material to fill the time, allowing time for discussion, breaks, questions, demonstrations the session may call for, as well as a final review or summary of material presented. You

may need to actually time your presentation to see how long it takes. If, for example, your session calls for each trainee to operate a motor grader, try to judge how much time each trainee will need.

If it is possible to do so, and you are presenting material for the first time, have a "dry run" with persons who know the material to see if they think your presentation is clear.

You can also time your progress during the training session: whether you are using too much time, or if you are going to have time left over.

Organize your material so that it follows the training session's topic

The points you present in one session must fit together in the same way one training session fits with other sessions in the total training program. If you are explaining how to do something, make each point follow the order of how that something should be done. Explain one point at a time. Don't hop back and forth. Be sure trainees understand each point before going to the next.

Be prepared to explain why something is done as well as how to do it

Besides learning how to do their work, trainees should understand why their work should be done in a certain way.

Plan different ways to approach the material you are going to cover

Think of more than one way to express a thought or idea. You may need to explain something several times until all trainees get the point. Be prepared with different ways to express an idea.

Check to see if the material you plan to present answers some questions trainees might have

Put yourself in your trainees' place. If you were the trainee hearing what you had prepared, what questions would you have? The material you present should be clear enough to answer any questions you would have if you were the trainee. But remember that there should always be some questions from trainees.

Decide on the training aids you need to help explain your points and find out what arrangements are needed to secure the aids

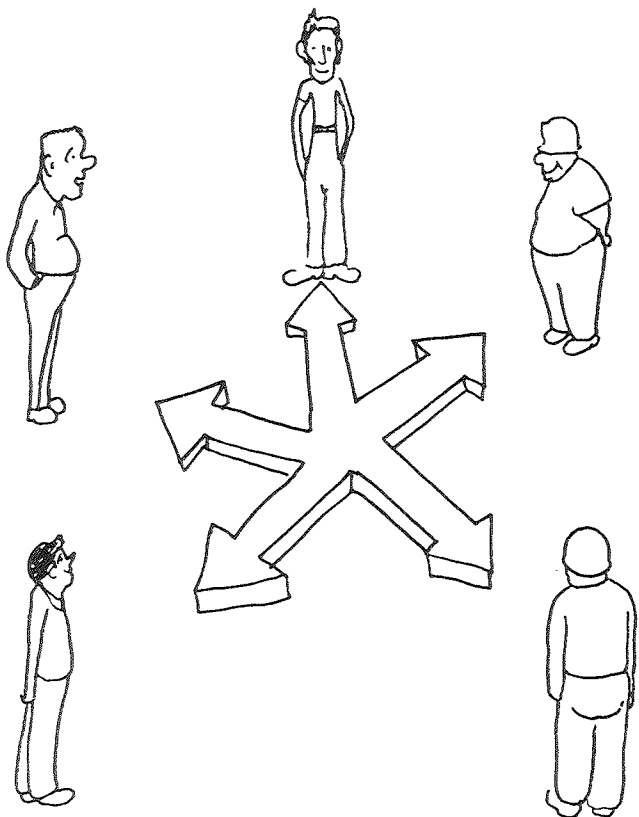
If you are working out in the field and need to demonstrate how to use a piece of equipment or how to work with certain tools, arrange for the equipment and tools to be at the job site. If you are training in a classroom-garage, or in an office, and need a blackboard, chalk, and eraser, arrange for them to be where you need them.

Advance planning gives you a chance to review material so that it is fresh in your mind. Proper planning also gives you an opportunity to revise your training program as needed. For example, you may schedule a particular session for a new topic, but after noting your trainees' progress, you may decide to review topics already covered before moving onto a new one.

Get Set

There are several things you need to do to get set for training. You and your trainees must be prepared:

- Know your trainees as individuals
 - Know each trainee's name and the work he normally does in the department
 - Learn each person's skills and areas of strength and weakness, including physical impairments (if, for example, an individual is hard of hearing, color blind, etc.)
 - Find out who has had prior training and what kind of training (the individual who has had prior training could be a potential assistant)
- Introduce yourself to those in the group who don't already know you
- Explain the reasons why the department is conducting the particular training program you are leading and what the program hopes to accomplish. Explain the training in terms of benefits to each trainee and to the road department. It is important that trainees feel they are participating in something worthwhile



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- Explain how you are going to conduct the course. Give a broad overview of the training program: topics to be covered, time period to cover topics, training methods you plan to use, etc.

(Explanations described in the two items above are necessary when you conduct some formal training programs; e.g., classroom-garage or lengthy on-the-job training. Such explanations are not necessarily required when you conduct a brief training session.)

- Encourage each trainee to participate: to make suggestions, to ask questions and to relate their experiences and problems with their jobs

Remember that each person is different and that everyone will not learn at the same pace. You must be aware of individual differences so you can help each according to his own particular needs.

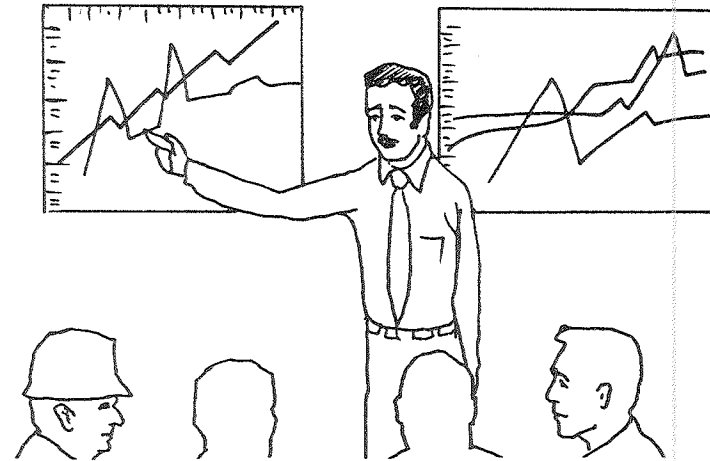
Go

Now that you have planned for your training session, it is time to GO.

Introduce the training session's topic. Give an overview of this particular session and briefly explain how the topic at hand fits into the total scheme of the training program. For example, if you are conducting a training program on bridge maintenance and devoting a session to traffic services, explain how traffic services relates to bridge maintenance: that crews must have equipment (cones, barricades, flags) to guide traffic because of safety for crews and the traveling public.

COVER THE TOPIC THOROUGHLY

- Explain the why as well as the how. Emphasize cause and effect relationships by pointing out what will happen when the job is done the proper way and what will happen when it is not. Also explain when trainees should follow a particular method or procedure. For example, explain that they should blade preferably when aggregate is moist; that, usually, if they blade when aggregate is dry, aggregates will loosen, traffic will fan aggregates into ditches, fines will blow away — harming the road, polluting the air, and possibly destroying crops
- Use training aids to clarify the point you're making. You can draw your own sketches or diagrams; you can use



illustrations from a book; maps and charts from the county engineer's office; or diagrams from a manufacturer of a given product or piece of equipment

- Present the how to's in a logical order and emphasize the actions involved. Start with the first step of a procedure, then move on to the second step, followed by the third, etc. Start with simple ideas and then proceed to more complex ones. Make sure trainees understand the simple ideas before you proceed to the more complex ones
- Try to anticipate some questions trainees might ask about points you are presenting and answer them in your explanation. Also anticipate problems that might arise (for example, what to do if needed materials are not at the job site; what to do if a piece of equipment breaks down), explain them, and present ways of solving them
- If possible, present your material in more than one way. You are dealing with different people with different aptitudes who confront problems and situations in various ways. If you explain the whys and the how to's in different ways, you are more apt to come across an

approach that will “click” with most of your trainees — one that they will understand because it clearly gets the point across in the particular way they see things. For example, one trainee who has had only urban experiences will understand terms differently than another trainee who has had only rural experiences working with farm equipment

- Explain how and demonstrate how. Actions often speak louder than words, but if you are using words, speak clearly and loud enough to be heard



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- Give each trainee a chance to actually do what you have explained and demonstrated
 - Carefully observe the trainee: what he is doing correctly and what he is doing incorrectly
 - Give each trainee individual attention. Work patiently with each until he can do the job. Understand that each person learns at his own pace and that you may have to spend more time with some individuals than with others
 - Correct mistakes immediately so that the trainee knows right away what he is doing incorrectly. Try to use an indirect approach. Rather than directly telling the trainee what he is doing wrong, point out where he is having difficulty and lead the way so he can find out for himself how to correct his mistakes. Ask the trainee what he thinks he is doing wrong
 - If one individual is having a lot of problems, work with him separately and be patient
- Emphasize to each trainee the progress he is making
- Praise and compliment each trainee on his progress and for good work
- Encourage trainees to ask questions and to tell you when they are unsure or do not understand something. Questions indicate how well trainees understand and what you need to emphasize or re-explain
 - Patiently answer each question until the trainee understands
- Make sure you keep control of the training. Don't allow discussion to wander off into unrelated subjects
- Toward the end of the session, review what you have explained during the session

13

- Tell interested individuals where they can find additional information on the topic

What follows is an example of a training session on reshaping an aggregate surfaced road as part of a training program on blading. The example illustrates how to implement and apply the ideas on training just described. The training takes place out in the field at the job site — it is on-the-job training — and involves a trainer (Bill) and a group of three trainees: John, Rod, and Ralph. Bill is speaking.

Today we're going to cover reshaping: what it is and how to do it. Reshaping is a major and important part of the total blading operation. The skills you use to reshape depend a lot upon the blading information we have already covered: mixing aggregates, fines, crust, blading to smooth a surface and to keep a crown on the road.

Before you can reshape, you have to know what reshaping is and why you need to do it.

Reshaping is the blading into a proper crown of the aggregate surface you have properly mixed into a blend of fines, coarse aggregate, and moisture. In preparing this aggregate mix, it was necessary to break up the old crust and mix it with sufficient fines and

introduce topic: what you are going to accomplish; show that topic is part of the total training program

review material already covered in other sessions; build upon previous sessions

explain what

moisture to produce a plastic, concrete-like material. As with smoothing, reshaping should be done when the aggregate is moist. If reshaping is done in dry weather, you must add water to the aggregate to make it moist.

Why do you need to reshape? You reshape to correct conditions in the road, such as potholes and washboards, that could be hazardous to drivers and could damage vehicles traveling over the road. By doing a proper reshaping job, you could prevent an accident, even save a life, and extend the life of the cars traveling over the road. In reshaping you also conserve the aggregate by consolidating it into a crust.

Let's take a careful look at these potholes in the road. As hard as the crust is, can we break it to the depth of the potholes with just the blade? With a three inch average depth, it is too much for just the blade.

How do we do it? What equipment do we need? What do we need to know about the crust?

The crust is usually two to three inches in depth, and its hardness (density) will depend on the gradation of the coarse and fine aggregate

explain when

explain why: use cause and effect relationships

use training aids; potholes are "real life" training aids

anticipate questions trainees may ask

explain

gates together with its moisture content. A good crust is the product of a skilled grader operator exercising his best judgment in blending the available aggregates.

The crust is nearly three inches thick and too hard to economically break up with the blade. We will have to use a scarifier.

The scarifier is an attachment to the grader. It has a variable number of slender metal teeth which are forced into the crust, and they act like small steel plows.

How do you attach the scarifier to the grader?

First you place the scarifier on the ground in front of the grader. Drive the grader forward over the scarifier until the lift arms are directly below the lift mechanism. Raise the arms and pin or bolt them into place.

I'll demonstrate how.

Okay, John, why don't you try attaching the scarifier to the grader? Be careful not to pinch your fingers and keep your foot out from under the teeth.

follow logical order

describe

follow step-by-step order

demonstrate as well as explain

involve trainees and coach them

Very good.

Ralph, why don't you give it a try?

That's good.

Your turn now, Rod.

Fine.

Now, how do we use the scarifier to break the crust? — by forcing the scarifier teeth into and under the crust as you move the grader ahead.

Now let's consider how much crust we need to break up; how large an area we're working in; how deep we should go.

Keep in mind that we are reshaping a section of road with many deep, sharp-edged potholes, so you need to scarify the full depth of the potholes.

What if we were working over on Lake Avenue and there were just a few, not very deep potholes? Would we do something different? What do you think, John?

Yes, we could just blade the potholes without using a scarifier.

comment on each trainee: emphasize the good points

proceed in logical order

cover the point thoroughly

cover the point thoroughly by applying the particular situation to a different situation and anticipating problems that might arise by doing so; involve trainees

Okay, Rod, give it a try. Remember not to go so deep as to bring up fill dirt.

You seem to be having a little difficulty keeping a set depth on the scarifier. What do you think you should do?

How about applying less pressure so the scarifier doesn't go down so deep?

Good — you've got it now.

Your turn, John.

Very fine.

Your turn now, Ralph.

What about the way you are leaning the front wheels on the grader? What do you think you should do?

Okay, much better.

Do you have any questions about breaking the crust?

I think each of you knows how to do it and with more practice you'll do it even better.

18

use an indirect approach: encourage trainee to discover solution himself, but help and guide him

comment on each trainee

encourage trainee to discover solution himself

solicit questions

Okay, what next? We have the crust broken, and you have bladed the aggregate into a windrow, recalling our previous session on how to handle windrows. Now, do we have a proper blend of aggregates and fines to work with? How do we know we have the proper blend?

It is a good compact mixture in a plastic workable condition somewhat resembling concrete and looks like it would pack down. Or think of it this way: it no longer ravel and breaks up as it rolls off the end of the blade and it looks plastic-like.

What should we do now? What is the next step after remixing the aggregate base, making sure we have the proper mix, and breaking the crust by scarifying?

Next we must blade the windrow of well-mixed aggregate half on each side of the center of the road and shape the material into an A-type crown. We will do this during our next session and will begin by reviewing how to achieve a proper A-type crown.

19

proceed in logical order

anticipate questions and answer them in your presentation

present another way of getting the point across

review, summarize what you have covered

conclude

HIGHWAY RESEARCH RECORD

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Maintenance
Management
1967

7 Reports

Subject Area

12 Personnel Management
40 Maintenance, General

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Appraising Results Derived from a Maintenance Training Program

A. P. CUNLIFFE, Department of Highways, Ontario

•THE quantity of salt used by the Department of Highways, Ontario, for snow and ice control increased from 1956 to 1966 by an average of 11 percent annually. The quantity of treated sand used during the same period increased by 4.3 percent annually. Since the highway mileage serviced by the Department has been increasing annually by an average of 2.3 percent, it is evident that the increased use of salt is only partly due to the increased mileage. It is generally believed that the increased use of deicing materials has resulted in an improved level of service on highways throughout the Province.

The Department's organization for winter maintenance is shown in Figure 1. There are 18 districts. In each district there are approximately four patrol supervisors reporting to the maintenance supervisor, five patrolmen (front line supervisors) reporting to each patrol supervisor, and twelve winter maintenance employees (snowplow operators, etc.) directed by each patrolman or his counterpart night patrolman on the second and third work shifts. Most of the salt and treated sand used for snow and ice control is spread by hired truckers using Department spreaders mounted on their trucks. These personnel also work under the direction of the patrolman or his counterpart.

Late in the winter of 1965-66 a Province-wide survey was conducted during a major snowstorm and each district was required to submit data pertaining to salt usage during and immediately after the storm, i. e., quantity of salt used, number of applications, and total mileage treated. This information was correlated and it was found that the rate of application varied between 300 and 1200 lb per 2-lane mile. This divergence occurred not only among districts but also among characteristically similar patrols in the same district. There was evidence that poor control of the rate and frequency of application were prime factors in the increased use of salt for snow and ice control.

Inasmuch as the annual bill for bulk salt had reached \$4 million by 1966, it was obvious from the survey that effective control at the operations level, of the rate and frequency of application, would result in considerable savings. Accordingly, prior to the 1966-67 winter maintenance season, a uniform application rate was prescribed and all districts were instructed to calibrate their hydraulic spreaders to spread salt at this rate—450 lb per 2-lane mile. A truck speed of 20 mph was used in calibration. Simultaneously, a training program on the use of salt for snow and ice control was developed and presented in each district.

In 1965 the Department had retained the consulting firm of Roy Jorgensen and Associates to direct a research project to study its maintenance function. From this research a maintenance training group was organized to develop training materials aimed at field personnel. The first training program developed, "The Use of Salt for Snow and Ice Control," was conducted in the fall of 1966 and evaluated the following spring. This paper describes the manner in which this training program was developed and administered, and the conclusions drawn from its evaluation.

THE TRAINING PROGRAM

It was suggested that an approach be adopted similar to the one effectively used by the Virginia Department of Highways in their program on snow and ice control. Initially,

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it was necessary to determine the content and scope of the training program. Accordingly, a training committee was formed consisting of a district engineer, two district maintenance engineers, and two maintenance supervisors, all with considerable experience in maintenance operations. It was determined that the program, should cover the following five main subject areas:

1. Why salt is used for snow and ice control,
2. When it should be used,
3. How much should be used,
4. Where it should be placed on the road, and
5. How it should be placed there.

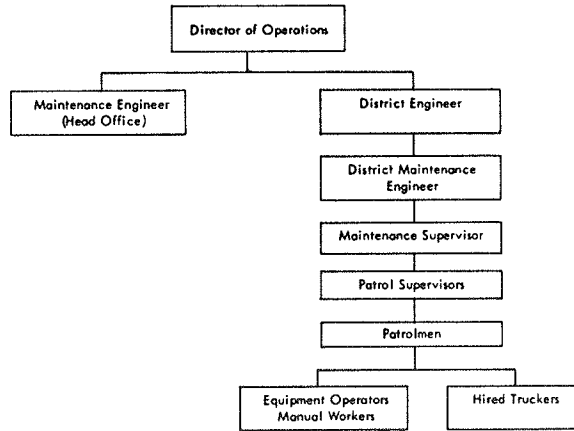


Figure 1. Winter maintenance organization.

The next decision was who should be trained. It was determined arbitrarily that the training should be directed toward the following two groups: all field staff required to make decisions pertaining to winter maintenance operations, i.e., patrolmen and night patrolmen; and all hired truckers. Finally, decisions were necessary concerning the form the training program should take, and how and by whom it should be conducted. It was decided that—

1. The major part of the program was to consist of an illustrated training aid in the form of a flip chart, 24 by 18 in. in size.
2. The chart was to be prepared for district maintenance engineers and maintenance supervisors to use as a focal point of discussion at meetings attended by patrol supervisors and patrolmen.
3. The flip chart was to be issued to all patrolmen so that they could train their night patrolmen and hired truckers.

Implementation

The flip chart was presented to the district maintenance engineers and maintenance supervisors at meetings held in each of the five Province regions to demonstrate its use as a training aid. Each district maintenance engineer was instructed to use the flip chart to train patrol supervisors and patrolmen; the patrolmen then trained their subordinate staff.

Preliminary Evaluation

At the midpoint of the winter maintenance season a preliminary evaluation of the training program was made and each district was asked the following questions:

1. How many meetings were held at which the flip chart was used as a training aid by the district maintenance engineer or maintenance supervisor?
2. What were the minimum and maximum number of people in attendance at meetings?
3. How many people received this training firsthand?
4. Approximately how many patrol supervisors, patrolmen, equipment operators, manual workers, and hired truckers attended each meeting?
5. How do you rate the flip chart as a training aid? Did it afford any real assistance in making your presentation?
6. How did your staff react to this training program? To what degree did they exhibit interest or indifference?

TABLE 1
SUMMARY OF INFORMATION PERTAINING TO TRAINING MEETINGS HELD IN EACH DISTRICT DURING FALL 1966

District	Total No. of Employees	Number of Meetings Held	Size of Meetings	Total Employees in Attendance	Classification of Those in Attendance							
					Patrol Supvrs.	Patrolmen	Night Patrolmen	Equipment Operators	Manual Workers	Hired Truckers	Others	
1	197	3	14 to 21	50	3	19		5				
2	286	17	10 to 27	255		18		129	45	63		
3	397	14	10 to 36	321	5	25		219	24	42	6	
4	554	11	8 to 50	278		-106 -				72	102	
5	341	17	6 to 20	175-200		*		*		*		
6	467	NA	NA	NA								
7	351	3	25 to 30	82	3	17		58		4		
8	412	2	5 to 10	15	1	3	10	1				
9	301	9	14 to 32	185	4	26	88		22	17		
10	178	1	21	21	3	18						
11	217	7	5 to 18	94	4	15	18	32		25		
13	189	6	12 to 16	80	2	18	48			6	6	
14	218	12	9 to 28	230	3	13		90	112	12		
16	127	4	9 to 28	62	2	9		34	5	5	7	
17	289	2	27 to 44	71	4	16		36		15		
18	283	10	4 to 12	61	5	13		39		7		
19	232	13	7 to 27	171	3	21		77	58	12		
20	167	5	3 to 11	30	5	19	3					3

*Numbers not available.

A summary of the replies to questions 1, 2, 3, and 4 is given in Table 1. It is apparent that while some district maintenance engineers left the training of patrol staff and hired truckers to their respective patrolmen, others trained considerable numbers of equipment operators, manual workers and hired truckers themselves. Responses to questions 5 and 6 indicate that the majority of district maintenance engineers and maintenance supervisors found the flip chart to be of considerable assistance in stimulating active discussion and maintaining interest at training sessions.

THE POST-TRAINING TEST

Toward the end of the winter maintenance season a post-training test (see Appendix) was given to a representative sample of field personnel to ascertain the current level of knowledge and to evaluate the training program, particularly the training aid. The post-training test was designed to cover almost the entire content of the illustrated training aid. A variety of techniques were used, e.g., true or false, multiple choice, and written answer, and in several cases questions were formulated so that the correct answer could come only from the training aid.

Implementation

All districts were instructed to test three people on each patrol who were using salt for snow and ice control, the patrolman, a night patrolman, and a hired trucker. The tests were given without forewarning and under supervision and only to those who had been exposed to the training program. To minimize "examination jitters" the testee was asked only to state his classification on the test paper—not his name.

When the testee handed in his test paper he was given a facsimile with correct answers, so that he could assess his own performance. It was believed that this would reinforce him in subject areas where he had responded correctly and alert him in those where he had responded either incompletely or incorrectly.

Marking

Before the test papers were marked each answer was given a value according to its relative importance. An attempt was made to mark with consistency, particularly where it was necessary to interpret partially-correct answers.

COMPILATION AND EVALUATION OF RESULTS

The results for each district were compiled in two ways:

1. The total mark obtained by each testee was tabulated and grouped according to job title. The results for a typical district are given in Table 2.

2. The average mark obtained by each of the three groups was, for each question and part question, tabulated under the appropriate heading as given in Table 3.

Following these analyses, the average mark obtained by each of the three groups, and the number in each, was tabulated for every district in the Province under the appropriate heading, as given in Table 4.

To evaluate the training program in detail it was necessary to analyze the responses to each question and part question as made by the patrolmen, night patrolmen, and hired truckers in each district, and in the Province as a whole. The degree of accuracy to which each group in each district answered was expressed as a percentage and tabulated as in Table 3. Similarly, information for each group at the Provincial level was tabulated (Table 5).

These data were considered indicative of the current level of knowledge in each district. The test score of 75 percent was arbitrarily selected as being indicative of a satisfactory level of knowledge. It was thought that this information shows the effectiveness of the training program in each district. Evaluation of the data in Table 4 shows that there was a spread of 30 percentage points between the lowest combined average mark of 61 percent in district 1 and the highest of 91 percent in district 6. The remaining districts were fairly evenly interspersed between these limits. There

TABLE 2
SUMMARY OF TOTAL MARKS OBTAINED IN POST-TRAINING TEST BY TESTEES IN DISTRICT 1

Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)
84	78	77
81	72	72
81	72	70
78	69	69
75	69	65
75	66	63
74	65	62
73	59	59
73	40	51
66	34	51
66	27	45
64		41
60		34
59		24
52		
50		
48		
47		
43		
66	59	56

TABLE 3
SUMMARY OF AVERAGE MARKS OBTAINED BY TESTEES IN DISTRICT 1 FOR EACH QUESTION IN POST-TRAINING TEST

Question	Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)	Combined Results (44)	Question	Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)	Combined Results (44)	
1	82	55	82	75	9	46	30	21	34	
	58	55	50	55	10	95	100	86	93	
2	63	73	64	66		79	27	36	52	
	84	73	93	84		47	82	43	55	
	58	64	64	61		100	100	79	93	
3	84	82	79	82		21	55	29	30	
4	55	27	29	40		37	36	29	34	
5 (a) (i)	95	90	93	93		5	18	21	14	
	(ii)	68	79	70	11	100	90	86	91	
	(iii)	5	7	7		47	10	16	28	
	(iv)	63	93	74		84	70	79	79	
	(b)	47	29	36		84	70	36	65	
6	84	70	79	79		100	100	86	95	
	74	80	79	77		79	80	57	72	
	82	85	64	77		58	90	93	77	
	84	90	79	83		100	100	79	93	
	74	65	57	66		89	90	93	91	
	65	41	43	51		95	60	86	84	
	61	50	50	55	12	70	50	21	49	
	50	70	79	64	13	39	36	29	35	
	82	75	71	77	14	86	59	71	74	
	21	20	50	30	15 (a)	94	55	43	68	
7	63	50	79	65		(b)	78	73	50	68
8	74	80	43	65						

TABLE 4
SUMMARY OF AVERAGE MARKS OBTAINED IN POST-TRAINING TEST BY
TESTEES IN EACH DISTRICT

District	Patrolmen		Night Patrolmen		Hired Truckers		Combined	
	No.	Mark	No.	Mark	No.	Mark	No.	Mark
1	19	66	11	59	14	56	44	61
2	15	78	38	77	24	75	73	77
3	26	78	33	78	20	77	79	78
4	34	71	9	70	77	61	120	65
5	19	77	19	70	25	71	63	73
6	12	91	9	91	0	—	21	91
7	17	78	36	77	4	76	57	77
8	4	89	9	83	0	—	13	85
9	18	75	26	67	7	67	51	70
10	18	75	15	72	21	68	54	72
11	13	82	11	85	7	79	31	82
13	18	88	19	86	6	89	43	87
14	11	81	9	80	10	81	30	81
16	9	80	7	77	0	—	16	79
17	16	91	29	89	5	88	50	90
18	13	69	15	64	9	65	37	66
19	15	80	8	74	9	75	32	77
20	26	74	2	78	0	—	28	74
Total	303	78	305	76	238	69	846	75

was a greater disparity in the average marks of patrolmen, night patrolmen, and hired truckers in those districts with combined average marks at the low end of the scale, than those at the high end. For example, district 1, with a combined average mark of 61 percent, recorded average marks of 66, 59, and 56 percent for patrolmen, night patrolmen and hired truckers, respectively, while district 17, with a combined average mark of 90 percent, recorded comparable average marks of 91, 89, and 88 percent.

The combined average mark in any district was generally assumed to reflect the relative effectiveness with which the training program had been conducted in that district.

TABLE 5
SUMMARY OF AVERAGE MARKS OBTAINED IN POST-TRAINING TEST BY
TESTEES IN THE PROVINCE AS A WHOLE

Question	Patrolmen (303)	Night Patrolmen (305)	Hired Truckers (238)	Combined Results (846)	Question	Patrolmen (303)	Night Patrolmen (305)	Hired Truckers (238)	Combined Results (846)	
1	95	91	85	91	9	53	50	40	48	
	81	79	72	78	10	95	97	85	93	
2	84	84	72	80		57	56	36	51	
	96	92	88	92		88	94	87	90	
	83	82	73	80		96	97	89	94	
3	93	93	92	92		70	72	61	68	
4	73	66	58	66		45	46	35	42	
5 (a) (i)	98	98	94	97		54	62	56	58	
	91	89	90	90	11	97	96	95	96	
	(ii)	91	90	90		58	61	44	55	
	(iii)	22	12	20		89	91	88	89	
	(iv)	85	91	85		91	87	79	86	
	(b)	52	43	50		99	99	93	97	
6	87	92	83	87		81	85	77	81	
	92	93	91	92		76	80	86	80	
	96	95	90	94		93	93	93	93	
	94	96	90	94		90	90	87	89	
	76	75	69	74		93	90	82	88	
	67	63	61	64	12	67	63	38	57	
	71	70	64	68						
	84	90	87	87	13	53	57	57	56	
	91	90	82	89						
	71	74	62	70	14	89	84	77	84	
7	91	87	85	88	15 (a)	76	67	57	67	
8	78	71	66	73		(b)	75	72	60	70

This assumption appeared even more valid after comparing the average marks obtained by the patrolmen, night patrolmen, and hired truckers in those same districts.

CONCLUSIONS

1. The training program was considered successful in that almost 60 percent of the participants scored at least 75 percent on the post-training test. A summary of the total marks obtained by each testee is shown in the form of a frequency-distribution chart in Figure 2. It was felt that a greater degree of success would have been attained if more specific direction had been given to districts as to how the program was to be administered, by whom, and to whom; and if the program had included more follow-up.

2. The post-training test was not in all cases administered by the districts in the manner requested. This cast some doubt on the validity of some of the results. It is important that a post-training test be administered under strictly controlled conditions to a sufficiently large, representative sample of the population.

3. Evaluation of the training program would have been somewhat more meaningful had the level of knowledge prior to training been known. Administration of a pre-training test, similar in content to the post-training test, to a representative sample of the personnel to be trained would have provided a sound basis for measuring the effect of the training program.

4. Where questions contained in the post-training test had been poorly answered by a large percentage of the total testees, some difficulty was experienced in ascertaining whether the deficiency lay in the training program or in the specific test question. This emphasizes the necessity of field-testing the training (or testing) materials before distribution, to insure that the personnel to whom they are directed fully understand the content.

5. No attempt was made to determine the effect of the training program on field performance. However, the following observations were made: some districts were of the opinion that the training program resulted in the improved use of salt and an overall reduction in its use. Other districts felt that the emphasis placed on salt in the training program had encouraged some patrolmen to use salt where they had previously used treated sand. This resulted in increased salt consumption, but to what extent this was offset by a decrease in the use of treated sand is not known. In comparison with previous years there was a leveling-off in salt consumption even though the winter maintenance season in question was thought to be worse than usual.

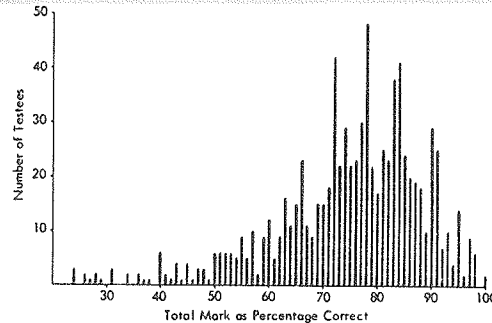


Figure 2. Summary of total marks obtained in post-training test.

Appendix

POST-TRAINING TEST
(See Following Sample Pages)

District _____

Patrolman

Night Patrolman

Trucker

1. Fill in the blanks.

The standard rate of application for salt is 450 lb. per 2 lane mile of road.

To salt 6 miles of 4 lane highway, you would expect to use 5400 lb. of salt, at the standard rate of application.

2. Fill in the blanks.

A truck has been calibrated to spread salt on a 2 lane highway at the standard rate of application. The speed posted on the dashboard is 18 m. p. h.

How much salt would it spread per mile of driving at the following speeds?

9 m. p. h.	<u>900</u>	lb. per mile
18 m. p. h.	<u>450</u>	lb. per mile
36 m. p. h.	<u>225</u>	lb. per mile.

3. Cross out the incorrect answers.

Driving faster than the posted speed will mean -

~~more salt spread per mile~~
less salt spread per mile
~~no change in salt spread per mile~~

4. Circle the correct answer.

If you were given the choice of spreading salt in any of the following widths, which one would you choose?

4' 1' 7½' 12' 9' 2' 1½' 6'

5. a) Describe where on the pavement (right, left or centre) you would put salt on the following:

- 1) straight section of road CENTRE
- 2) curve to the left, super elevated (banked) RIGHT
- 3) curve to the right, super elevated CENTRE
- 4) curve to the right, not super elevated CENTRE

b) State one rule to say where on the pavement salt should be spread, whether on a curve or on a straight section of road.

ON THE HIGHEST POINT OF THE PAVEMENT

6. Against the temperatures listed, write down whether you feel the temperature is good, fair, or poor, for salting operations assuming all other conditions to be favourable.

15° F	<u>FAIR TO GOOD</u>	18° F	<u>GOOD</u>
-7° F	<u>POOR</u>	10° F	<u>FAIR</u>
29° F	<u>GOOD</u>	-12° F	<u>POOR</u>
0° F	<u>FAIR TO POOR</u>	23° F	<u>GOOD</u>
12° F	<u>FAIR</u>	-25° F	<u>POOR</u>

7. At 450 lb. per 2 lane mile, how many miles of 2 lane pavement would you expect to salt with a 5 ton load of salt?

22 MILES APPROX.

8. Why is it important to spread salt early in a storm?

SO THAT BRINE WILL FORM UNDER THE SNOW AND PREVENT THE SNOW FROM STICKING TO THE PAVEMENT

9. Why is it important to spread salt early in the day?

TO TAKE ADVANTAGE OF THE SUN, TRAFFIC AND HIGHER DAYTIME TEMPERATURES, WHICH MAKE SALT WORK BETTER

10. Answer 'yes' or 'no' to indicate whether you would or would not use salt given the following conditions. If you are in doubt, or feel you would need more information, leave blank.

Weather	Time	Temperature	Forecast	Road Condition	Answer
Started Snowing	11 a. m.	23°	Continuous snow. Steady temp.	Lightly snow covered	YES
Clear	6 a. m.	0°	Clear	Ice patches	YES
Cloudy	4 p. m.	10°	Falling temperature	Ice and snow patches	NO
Sunny	10 a. m.	8°	Clear	Pavement dry Snow blowing across pavement	NO
Sunny	5 p. m.	10°	Clear	Icy	NO
Overcast	9 a. m.	25°	Snow	2" of snow	NO
Sunny	10 a. m.	20°	Clear	Snow pack covered	NO

11. Mark true or false.

- | True | False | |
|-------------------------------------|-------------------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Salt works better at higher temperatures. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Salt sometimes works at temperatures below 0°. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Traffic has very little effect on how well salt works. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | The reason for salting early in the day is to take advantage of lower traffic volumes. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | When snow is blowing off the road and is not sticking, the use of salt may cause the snow to stick to the pavement. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Once salt has combined with the snow to form brine, it will not re-freeze even though the temperature goes down. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | As long as the temperature is warm enough, the salt will work, no matter what the other weather conditions are like (sun, wind, etc.). |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | You should never have a plow operating immediately behind a salt truck. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | You should never have a salt truck operating immediately behind a plow. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | After a snow storm has started, it is better to let snow accumulate to at least 1" before salting. |

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12. Describe what is meant by "a brine sandwich".

BY SALTING EARLY IN THE STORM A LAYER OF
BRINE IS FORMED BETWEEN THE SNOW AND THE
PAVEMENT

13. At 25° F, how long do you think should be allowed between salting and plowing to allow the salt time to work?

A MINIMUM OF 1/2 HOUR

14. One of the three things that affects the rate per mile that salt is spread with a hydraulic sander is the speed of the truck. What are the other two?

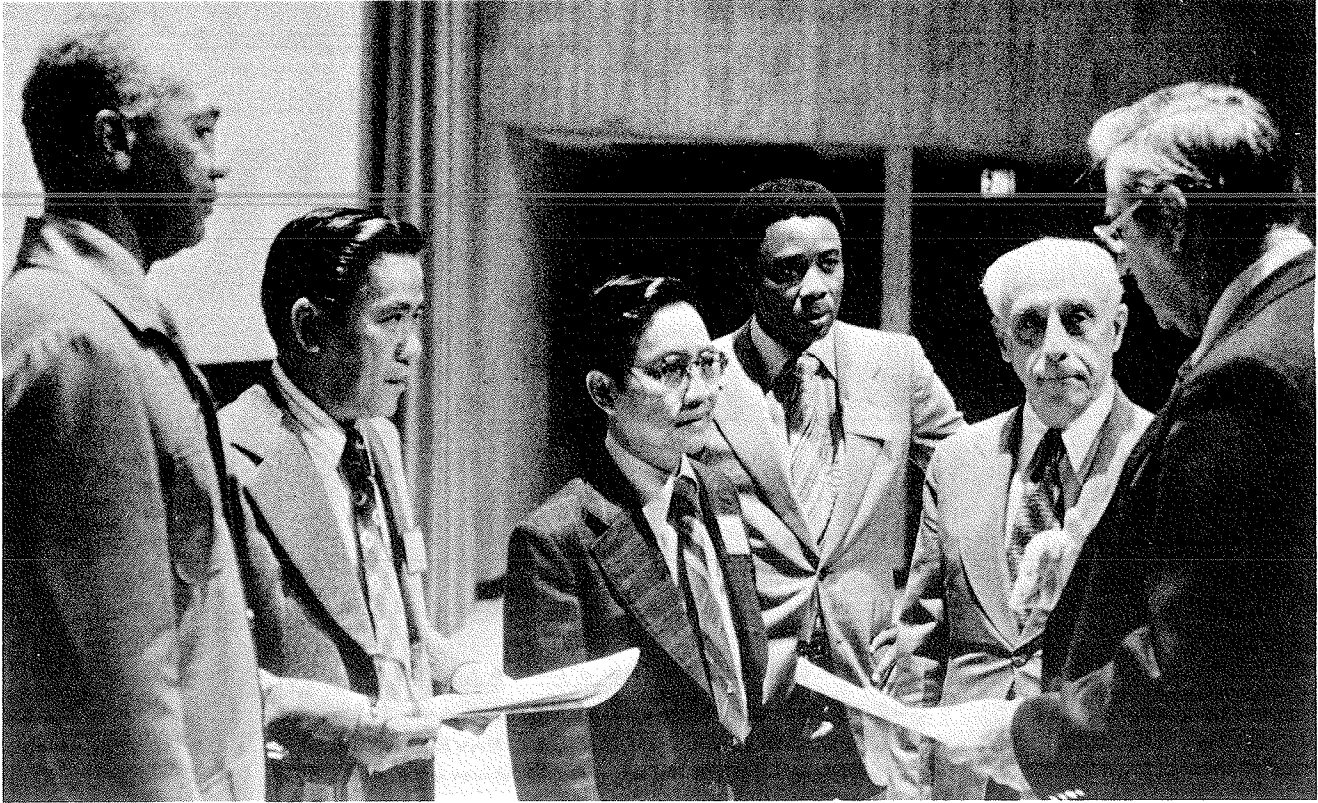
1. GATE OPENING 2. HYDRAULIC SANDER
MOTOR SPEED

15. a) Where would you set the gate opening on a hydraulic sander for salting operations?

AT THE PROPER SETTING FOR SALTING, MARKED ON
TRUCK DASHBOARD OR ON THE SANDER BODY

b) At what throttle setting do you run the motor on the hydraulic sander?

FULL THROTTLE



Project Correspondents P. A. Allsopp (Guyana), P. A. Caballero (Philippines), R. Diwiry (Indonesia), G. E. Oto (Nigeria), and L. R. Soares (Brazil) talk with Kermit L. Bergstralh, chairman of the Project Steering Committee for Transportation Technology Support for Developing Countries, at the Second International Conference on Low-Volume Roads, Ames, Iowa, U.S.A.

Bibliography

The following bibliography contains two sets of references. The first set consists of a reference for each selected text that appeared in the preceding part of this compendium. The second set consists of references to additional publications that either were cited in the selected texts or are closely associated with material that was presented in the overview and selected texts. Each reference has five parts that are explained and illustrated below.

(a) Reference number: This number gives the position of the reference within this particular

bibliography. It is used in the compendium index but should *not* be used when ordering publications.

(b) Title: This is either the title of the complete publication or the title of an article or section within a journal, report, or book.

(c) Bibliographic data: This paragraph gives names of personal or organizational authors (if any), the publisher's name and location, the date of publication, and the number of pages represented by the title as given above. In some references, the paragraph ends with an order number for the publication in parentheses.

Bibliografía

La siguiente bibliografía contiene dos series de referencias. La primera serie consiste en una referencia para cada texto seleccionado que apareció en la parte anterior de este compendio. La segunda serie consiste en referencias a publicaciones adicionales que fueron mencionadas en los textos seleccionados o que se asocian íntimamente con el material que se presentó en la vista general y los textos seleccionados. Cada referencia tiene cinco partes que se explican y se ilustran abajo.

(a) Número de referencia: este número indica la posición de la referencia dentro de esta bi-

bliografía en particular. Se utiliza en el índice del compendio pero *no* deberá utilizarse al pedir publicaciones.

(b) Título: el título de la publicación completa o el título de un artículo o sección dentro de una revista, informe, o libro.

(c) Datos bibliográficos: este párrafo da los nombres de autores personales u organizacionales (si hay alguno), el nombre del editor y su dirección, la fecha de publicación, y el número de páginas representadas por el título en la parte (b). En algunas referencias el párrafo termina con un número de pedido para la publicación en paréntesis.

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Bibliographie

La bibliographie qui suit contient deux catégories de références. La première catégorie consiste en une référence pour chaque texte choisi qui est inclus dans la partie précédente de ce recueil. La deuxième catégorie contient des références pour des documents qui ont soit été cités dans les textes choisis, ou soit sont étroitement associés avec des écrits qui sont présentés dans l'exposé ou les textes choisis. Chaque référence est composée de cinq parties qui sont expliquées et illustrées ci-dessous:

(a) Numéro de la référence: ce numéro indique la position de cette référence dans cette bi-

bliographie. Ce numéro est indiqué dans l'index du recueil mais *ne doit pas* être utilisé pour les commandes de publications.

(b) Titre : cela indique ou le titre du livre entier, ou le titre d'un article ou d'une section d'une revue, un rapport, ou un livre.

(c) Données bibliographiques: ce paragraphe indique les noms des auteurs personnels (quand il y en a) ou des auteurs collectifs (organisation), le nom de l'éditeur et son adresse, la date de l'édition, et le nombre de pages qui sont incluses sous le titre dans (b). Certaines références se terminent par un numéro entre parenthèses qui indique le numéro de commande.

(d) Availability information: This paragraph tells how the referenced publication is available to the reader. If the publication is out-of-print but may be consulted at a particular library, the name of the library is given. If the publication can be ordered, the name and address of the

organization from which it is available are given. *The order should include all information given in parts (b) and (c) above.*

(e) Abstract: This paragraph contains an abstract of the publication whose title was given in part (b).

(d) Disponibilidad de la información: este párrafo indica la disponibilidad al lector de la publicación referenciada de una de dos formas como sigue. (1) La publicación está agotada pero puede ser consultada en la biblioteca indicada, donde se sabe que se posee una copia, o

(2) la publicación puede ser pedida de la organización cuyo nombre y dirección están indicados. *El pedido deberá incluir toda la información dada en las partes (b) y (c).*

(e) Resumen: este párrafo es un resumen de la publicación cuyo título se dió en la parte (b).

(d) Disponibilité des documents: ce paragraphe indique les deux façons dont le lecteur peut acquérir les documents: (1) L'édition est épuisée, mais une certaine bibliothèque détient ce document et il peut être consulté. (2) Le document peut être commandé à l'organisation dont

le nom et l'adresse sont indiqués ici. *L'ordre de commande doit inclure toutes les informations données dans les parties (b) et (c).*

(e) Analyse: ce paragraphe est une analyse du texte dont le titre est cité dans la partie (b).

Illustration (from Comp. 1)	Ilustración (del Comp. 1)	Illustration (du Recueil 1)
(a) Reference number (a) Número de referencia (a) Numéro de la référence	→	Reference 5 A REVIEW OF HIGHWAY DESIGN PRACTICES IN DEVELOPING COUNTRIES
(b) Title (b) Título (b) Titre	→	Cron, Frederick W. Washington, DC: International Bank for Reconstruction and Development; 1975 May, 57 p.
(c) Bibliographic data (c) Datos bibliográficos (c) Données bibliographiques	→	Order from: International Bank for Reconstruction and Development, 1818 H Street, N.W., Washington, DC 20433.
(d) Availability information (d) Disponibilidad de la información (d) Disponibilité des documents	→	The design standards of some 150 highway projects financed by the International Bank for Reconstruction and Development between 1960 and 1970 are reviewed, and areas of agreement between the standards of the 63 countries studied are identified; practical highway standards based on these areas of agreement are sketched for the guidance of planners in developing countries. The roads discussed here, fall into three functional categories: a small group of expressways, freeways and toll roads carrying large volumes of traffic; a very large group of 2-lane highways carrying a wide range of traffic volumes serving both local and long distance traffic; and a smaller group of low-traffic tertiary or special purpose roads existing primarily for land service. Comments are made on the problem of classifying highway standards, and on the comparison of standards. Conclusions regarding standards for the capacity-related elements of design and standards for the velocity-related elements of design (radius of curvature, stopping sight distance, passing sight distance) are discussed, as well as the horizontal and vertical clearances for bridges. The standard live loadings for bridges, the structural capacity of pavements and legal load limits are covered, and conclusions relating to pavement design, design standards for 2-lane highways, incremental development of highways, and levels of service are presented.
(e) Abstract (e) Resumen (e) Analyse	→	
<p>The order should include all information given in parts (b) and (c) above. El pedido deberá incluir toda la información dada en las partes (b) y (c). L'ordre de commande doit inclure toutes les informations données dans les parties (b) et (c).</p>		

SELECTED TEXT REFERENCES

References 1

PROFESSIONAL TRAINING OF ROAD MAINTENANCE PERSONNEL

Neubauer, H.J. Bonn, Federal Republic of Germany: Federal Ministry of Transport; 1977; 40 p. (Pan African Conference on Highway Maintenance and Rehabilitation, Ghana, November 1977).

Order from: Transport and Road Research Laboratory, Overseas Unit, Crowthorne, Berkshire RG11 6AU, U.K.

This paper defines the training required for three personnel levels: top management, middle management and supervisory staff, and skilled labor. The personnel structure applicable to road maintenance services in African countries is described, and the selection of skilled personnel to be trained for higher qualified posts as well as the number and qualifications of the personnel required are discussed. The planning of training projects, current and future personnel needs analysis, preparation of training projects, selection of instructors, training project administration, training models (school training, on-the-job training, and long- and short-term training) are covered. The problems encountered in technology transfer, such as the provision of counterparts, insufficient planning and preparation, and the integration of newly trained personnel into the administration, are also discussed. The possibilities of Inter-African cooperation in training are considered. Tables are appended that present data on personnel structure of road maintenance services, training courses, factors conditioning the analysis of needs in road maintenance personnel, elements of training projects, subjects of instruction, planning training projects, and cost-benefit analysis.

Reference 2

ROAD MAINTENANCE TRAINING—THE WORK OF A SPECIALIST ORGANIZATION

Hamilton, I. 1977; 30 p. (Pan African Conference on Highway Maintenance and Rehabilitation, Ghana, November 1977).

Order from: Transport and Road Research Laboratory, Overseas Unit, Crowthorne, Berkshire RG11 6AU, U.K.

A specialist organization, Organization for Rehabilitation through Training (ORT), discusses its experiences and gives details of projects in road maintenance training in Africa. ORT, which was headquartered in Gevena, Switzerland, is now located in London, England. The general approach to such projects from initial survey through implementation to evaluation is outlined. Training programs (involving training centers and training production units) in Zaire, Chad, Tanzania and Nigeria are briefly summarized. Each program begins with a survey of the country's educational and training institutions, productive manpower available and the organization of the roads department. Labor needs are then related to the available labor, and a final report containing details of a plan of operations (including timetables, logistics, and budget) is prepared. This program will become the basis for a contract to implement the training effort. Evaluation is a

continuous element in all training projects and progress indicators are built into all phases and steps of the program. This includes evaluation of trainees as well as local professional managers and potential trainees.

Reference 3

PRINCIPAL FINDINGS OF TRAINING RESEARCH

Bergstralh, Kermit L. Gaithersburg, Maryland. 1978; 14 p. (presented at the Michigan Management Seminar, 1978).

Not Available.

This discussion of the training of large decentralized forces notes that only two training approaches have potential for consistent success: (a) train the supervisors and then train their employees; and (b) train the employees directly using special instructors. Eight training techniques that permit courses to be prepackaged for operating supervisors are identified. The training function consists of three main activities: methods and management system development; course design and production (performed by training specialists); and training implementation. The paper notes that supervisors make good instructors if the role is well defined, if instructor material is provided and if instructional training is provided. Costs of training (fixed costs, valuable costs) are considered, as well as benefit-cost relationships. Training must be supported by operating officials. Operating support is lost unless training pays off in terms of improved employee performance. Support is increased if operating divisions retain full control of work methods and management systems, and if those methods and systems are the bases of training.

Reference 4

TRAINING SUPPORT SERVICES

Direktorat Jenderal Bina Marga. Jakarta, Indonesia: December 1975; variable paging (Government of Indonesia; Final Report).

Not available.

The design of the Bina Marga training program and its organization are detailed, and the management principles on which it is based are defined. The details are given of the four major elements of the program: work methods, course production, training implementation, and program management. Training staff development is also covered. Bina Marga develops work methods and workmanship requirements for nationwide application through a technical panel representing operating directorates. The Central Training Unit produces training programs and courses. These courses are designed to meet individual variations in training needs and to permit supervisors to train full crews before undertaking such projects as excavation and embankment or asphalt surfacing. A library of training courses, instructors' guides, and supporting materials has been established in provincial public works departments; training implementation techniques have been developed; and provincial training officers have been instructed in their use. A system for managing the total program has been developed. The total manpower requirements for highway maintenance, rehabilitation, upgrading and construction work loads have been estimated. Standard engineering practices developed in other countries and training courses available from other high-

way agencies were used as guides for developing work methods.

Reference 5

METHODS EMPLOYED IN CONDUCTING A TRAINING NEEDS STUDY IN A MAINTENANCE DIVISION OF A STATE HIGHWAY DEPARTMENT

Bergstralh, Kermit L. Maintenance Management 1967; 7 Reports. Washington, DC: Highway Research Board; 1967; pp. 24-43. (Highway Research Record Number 241).

Order from: University Microfilms International, 300 North Zeeb Road, Ann Arbor, MI 48106.

Valid measures of training needs are made for current and potential maintenance supervisors. They reveal the most urgent needs and the best course content and form for training. Maintenance subject matter experts and experts in study techniques work as a team to accomplish the following: (a) ascertain the status of the total supervisory force on factors that affect learning by using employer records to find age, education, experience, and geographic distribution factors; (b) break down the tasks of each maintenance job and list them in job element statements to reveal the knowledge, skills, and abilities (KSA) needed to do the job, which are then combined into KSA statements; (c) measure how well a random sample of supervisors possesses the knowledge, skills, and abilities needed in their jobs (KSA-based written tests, performance tests, and supervisory appraisals are used and results are projected statewide to find the total number needing training on that KSA); and (d) measure the sample supervisors for their capacity to learn by using a standard test and using questionnaires, and interviews to see if they are willing and have time to take training. This report is part of a collection of seven reports that describe techniques applied to the management of the highway maintenance function as well as training, particularly the definition of training needs in connection with maintenance, and ways in which these needs are being satisfied. The other reports in the publication are as follows: Planning and Programming Highway Maintenance; Highway Maintenance Service Levels; An Approach to Performance Rating; Guidelines for Manpower Training as Developed by the Human Resources Research Office of the George Washington University; Teaching Methods Employed in a Maintenance Personnel Training Program; and Appraising Results Derived from a Maintenance Training Program (see Selected Text Reference 9).

Reference 6

MANAGING HIGHWAY MAINTENANCE IN VIRGINIA

Jorgensen (Roy) and Associates. Gaithersburg, Maryland: Commonwealth of Virginia Department of Highways and Transportation. December 1966; 150 p. and appendixes (Virginia Maintenance Study 1963-1966 Part IV of the Final Report). (Report # PB-175 811).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This report covers the final phase of a study in which a maintenance management system and related training materials were developed. The report is presented in three sections that cover the system that was developed, the improvement of maintenance performance, and the development of training materials, respectively. Section A recommends policies

and procedures and covers the development of performance standards, planning and programming maintenance work, and performance reporting. It also provides direct comparison between actual work performance and objectives. Section B lays out a pattern of management activity according to organizational levels and different types of operations that will result in significantly improved performance. The areas covered include management actions, the processes of controlling work performance, and an evaluation of the results of pilot testing the maintenance management system. Section C describes the policies and procedures followed in developing and using training materials related specifically to the causes of poor performance. The determination of training needs is covered and the relationship of the Personnel Division's training section to operating positions is discussed.

Reference 7

HANDBOOK ON TRAINING FOR ROAD DEPARTMENTS

Glassman, Marlene. Washington, DC: National Association of Counties, Research Foundation; 1974; 142 p. (National Association of County Engineers, Training Guide Series).

Order from: National Association of Counties, 1735 New York Avenue, N.W., Washington, DC 20006.

Information useful in training foremen and crews, including information about available training material, is presented in this handbook. The first section considers and benefits of training. The second section emphasizes the preliminary aspects to be considered before the start of training, namely the determination of training needs, the persons to be trained, and training priorities. The economics of training is considered in the third section. The kind of training, the length of course and the number of personnel will influence the costs of training. Scheduling of training is considered in section four. Training should be a part of the department's program and scheduled from year to year. The fifth section considers which kind of training to use and when. Training in blading is used as an illustrative example. Section six discusses the adaptation of training programs and materials from various sources by the county road departments. Inventories of training programs are useful in deciding on the best kind of training for individual needs. Section seven provides information on how to get the training done, discusses potential trainees within the highway department staff, and suggests outside resources. The evaluation of training is discussed in the eighth section. Improvement in the following areas indicates accomplishment: safety record, employee morale, productivity, and the department's image. Designed as a companion to this handbook is the booklet, Trainer's Guide (see Selected Text Reference 8) which provides guidance on the training of foremen and crews.

Reference 8

TRAINER'S GUIDE

Glassman, Marlene. Washington, DC: National Association of Counties, Research Foundation; 1974; 22 p. (National Association of County Engineers, Training Guide Series).

Order from: National Association of Counties, 1735 New York Avenue, N.W., Washington, DC 20006.

Information on training foremen and crews is provided for professional trainers (on the preparation of training programs and on the presentation of training sessions) as well as for supervisors training their own crews. The first section of the handbook deals with advance planning for the training, the second section, the preparation for the training; and the last, the training itself. This handbook is designed as a companion to the Handbook on Training for Road Departments (see Selected Text Reference 7).

Reference 9
APPRAISING RESULTS DERIVED FROM A MAINTENANCE TRAINING PROGRAM

Cunliffe, A.P. Maintenance Management 1967: 7 Reports. Washington, DC: Highway Research Board; 1968; pp. 50-58 (Highway Research Record Number 241).

Order from: University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

The manner in which a training program in the use of salt for snow and ice control was developed and administered, and the conclusions drawn from its evaluation are reported. A major part of the program consisted of an illustrated training aid in the form of a flip chart. A preliminary evaluation of the training program was made at the midpoint of the winter maintenance season and a post-training test was administered at the end of the season. The results were compiled and analyzed. Sample pages from the post-training test are presented in an appendix. This report is part of a collection of seven reports that describe techniques applied to the management of the highway maintenance function as well as training, particularly the definition of training needs in connection with maintenance, and ways in which these needs are being satisfied. The other reports in the publication are as follows: Planning and Programming Highway Maintenance; Highway Maintenance Service Levels; An Approach to Performance Rating; Guidelines for Manpower Training as Developed by the Human Resources Research Office of the George Washington University; Methods Employed in Conducting a Training Needs Study in a Maintenance Division of a State Highway Department (see Selected Text Reference 5); and Teaching Methods Employed in a Maintenance Personnel Training Program.

ADDITIONAL REFERENCES

Reference 10
DEVELOPMENT OF MANAGEMENT CAPABILITY

Highway Research Board. Washington, DC: 1972; 50 p. (NCHRP Synthesis of Highway Practice 11).

Order from: Transportation Research Board, Publications Office, 2101 Constitution Avenue, N.W., Washington, DC 20418.

Addressed to administrators of highway engineering organizations, highway personnel managers, and those responsible for training and development programs, this report offers information on policies and practices affecting training practices, recruiting, manpower development, and trends in public personnel administration. In a state highway organization, management capability is required for many positions. There is a relationship between knowledge and

management capability, and those desiring to acquire managerial competence in engineering organizations can begin by acquiring a knowledge of management. The key elements of the manager development system are identification of development needs, establishment of development objectives, planning and programming development activities, implementation, and evaluation. The commitment that is essential to the success of any development program is that the program be made a function of every manager in the organization. The responsibilities of each manager throughout the organization should include the coaching of his subordinates, an understanding of his own development needs, and responding to the coaching assistance from his supervisors. Planning for formal training efforts is important and should consider the subjects to be covered, trainer resources, training sites and training methods. College graduates joining the organization must be trained in management capability. The training must provide a selective blend of theoretical with empirical, practical experience.

Reference 11
TRAINING GUIDE AND CATALOG

U.S. Department of Transportation, Federal Highway Administration, Office of Research and Development, Implementation Division. Washington, DC: January 1973, 31 p. (Managing Highway Maintenance) (Report #PB-224 407/7).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This guide, intended for use by highway department officials, maintenance engineers and training officers, consists of three sections. The first describes the design features of the training materials—the course content, levels of instruction, training approaches, and instructor training materials. The second contains a training unit catalog with brief descriptions of the model training units. The catalog is organized by unit and management level. The first series of units covers the characteristics and problems of maintenance management. The second series establishes a framework for making decisions for planning and controlling work. The third series identifies the decisions and tasks required to plan and schedule work. The fourth series covers the concepts and techniques of effective work control. The last unit gives a comprehensive overview of management systems. The third section of the book covers the management of training, the prerequisites of effective training, who should take training, how training should be conducted, how training should be modified, and how training should be used in small agencies.

Reference 12
NOTES ON THE METHODOLOGY OF THE WRITING AND PRESENTATION OF MANUALS

Brunschwig, G.; George, A.; Mattei, O. 1977; 23 p. (Pan African Conference on Highway Maintenance and Rehabilitation, Ghana, November 1977).

Order from: Transport and Road Research Laboratory, Overseas Unit, Crowthorne, Berkshire RG 11 6AU, U.K.

These notes provide guidance on the principles of manual writing for engineers, technicians and workers in an African road department. The Notes discuss who should write such manuals. The writers of

manuals should consider the public for whom the manuals are written and define it as precisely as possible. A plan must be adopted regarding the nature of the work; should it be a textbook, guide, or a collection of manuals? A collection of manuals is sometimes preferable, with each manual devoted to a particular aspect but forming a whole, usable series without too many cross references, and with some repetitions from one manual to another. The Notes also comment on the style to be used and the presentation of the work. The importance of illustrations, even simple explanatory drawings, is stressed. Examples are given of noteworthy illustrations. The circulation of manuals and the use of programmed teaching are briefly discussed.

Reference 13
THE GEAR BOOK: AN INTRODUCTION TO GEARS

Bakke, John. Peoria, Illinois: Caterpillar Tractor Company; 1968 and 1976; 73 p.

Order from: the nearest local office of the Caterpillar Tractor Company.

This text is an example of a training manual with numerous illustrations. It is designed for apprentice servicemen to acquaint them with the many types of gears used in Caterpillar vehicles and to help them understand how gears perform specific functions. Full page illustrations allow the reader to identify the parts described in the text and relate them to the manual.

Reference 14
HYDRAULICS: AN INTRODUCTORY PROGRAMMED INSTRUCTION TRAINING COURSE

Caterpillar Tractor Company. Peoria, Illinois: no date. 54 p. (Form JE001407).

Order from: The nearest local office of the Caterpillar Tractor Company.

This text provides an example of a programmed self-instruction training manual. The information is presented in steps called frames. While reading the material in each frame, one is occasionally required to answer questions based on that material.

Reference 15
BRIDGE INSPECTOR'S TRAINING MANUAL 70

U.S. Department of Transportation, Federal Highway Administration. Washington, DC: Corrected Reprint 1979; variable paging.

Order from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

This manual provides guidelines for the training of bridge inspectors and is a guide both for instruction and for the conduct of bridge inspections. The manual outlines the primary duties of the bridge inspector, the essential requirements for the training of bridge inspectors, and the prerequisite qualifications for individuals selected for such training. A simplified classification of bridge types and a rudimentary explanation of simple mechanics are provided. The planning of a bridge inspection operation and the use of an inspection field book are explained, and the methodology and the procedural sequence to be followed in conducting a bridge inspection are described. The characteristics and weaknesses of the major construction materials are covered, and the nature and causes of foundation movements and the effects on bridges are explained. Typical structural deficiencies are covered in some detail. The methods of reporting inspection results and making recommendations are briefly discussed. The manual also contains a glossary of commonly used bridge engineering and inspection terms and a short bibliography.

Index

The following index is an alphabetical list of subject terms, names of people, and names of organizations that appear in one or another of the previous parts of this compendium, i.e., in the overview, selected texts, or bibliography. The subject terms listed are those that are most basic to the understanding of the topic of the compendium.

Subject terms that are not proper nouns are shown in lower case. Personal names that are listed generally represent the authors of selected texts and other references given in the

bibliography, but they also represent people who are otherwise identified with the compendium subjects. Personal names are listed as surname followed by initials.

Organizations listed are those that have produced information on the topic of the compendium and that continue to be a source of information on the topic. For this reason, postal addresses are given for each organization listed.

Numbers that follow a subject term, personal name, or organization name are the page numbers of this compendium on which the term

Indice

El siguiente índice es una lista alfabética del vocablo del tema, nombres de personas, y nombres de organizaciones que aparecen en una u otra de las partes previas de este compendio, es decir, en la vista general, textos seleccionados, o bibliografía. Los vocablos del tema que aparecen en el índice son aquellos que son necesarios para el entendimiento de la materia del compendio.

Los vocablos del tema que no son nombres propios aparecen en letras minúsculas. Los nombres personales que aparecen representan los autores de los textos seleccionados y otras referencias dadas en la bibliografía, pero también pueden representar a personas que de otra manera están conectadas a los temas del compendio. Los nombres personales aparecen con el apellido seguido por las iniciales. Las organi-

zaciones nombradas son las que han producido información sobre la materia del compendio y que siguen siendo fuentes de información sobre la materia. Por esta razón se dan las direcciones postales de cada organización que aparece en el índice.

Los números que siguen a un vocablo del tema, nombre personal, o nombre de organización son los números de página del compendio donde el vocablo o nombre aparecen. Los números romanos se refieren a las páginas en la vista general, los números arábigos se refieren a páginas en los textos seleccionados, y los números de referencia (por ejemplo, Ref. 5) indican referencias en la bibliografía.

Algunos vocablos del tema y nombres de organizaciones están seguidos por la palabra *see*. En tales casos los números de página del com-

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Index

Cet index se compose d'une liste alphabétique de mots-clés, noms d'auteurs, et noms d'organisations qui paraissent dans une section ou une autre de ce recueil, c'est à dire dans l'exposé, les textes choisis, ou la bibliographie. Les mots-clés sont ceux qui sont le plus élémentaires à la compréhension de ce recueil.

Les mots-clés qui ne sont pas des noms propres sont imprimés en minuscules. Les noms propres cités sont les noms des auteurs des textes choisis ou de textes de référence cités dans

la bibliographie, ou alors les noms d'experts en la matière de ce recueil. Le nom de famille est suivi des initiales des prénoms. Les organisations citées sont celles qui ont fait des recherches sur le sujet de ce recueil et qui continueront à être une source de documentation. Les adresses de toutes ces organisations sont incluses.

Le numéro qui suit chaque mot-clé, nom d'auteur, ou nom d'organisation est le numéro de la page où ce nom ou mot-clé paraît. Les numéros

or name appears. Roman numerals refer to pages in the overview, Arabic numerals refer to pages in the selected texts, and reference numbers (e.g., Ref. 5) refer to references in the bibliography.

Some subject terms and organization names are followed by the word **see**. In such cases, the compendium page numbers should be sought

under the alternative term or name that follows the word **see**. Some subject terms and organization names are followed by the words **see also**. In such cases, relevant references should be sought among the page numbers listed under the terms that follow the words **see also**.

The foregoing explanation is illustrated below.

pendio se encontrarán bajo el término o nombre alternativo que sigue a la palabra **see**. Algunos vocablos del tema y nombres de organizaciones están seguidos por las palabras **see also**. En tales casos las referencias pertinentes se encon-

trarán entre los números de página indicados bajo los términos que siguen a las palabras **see also**.

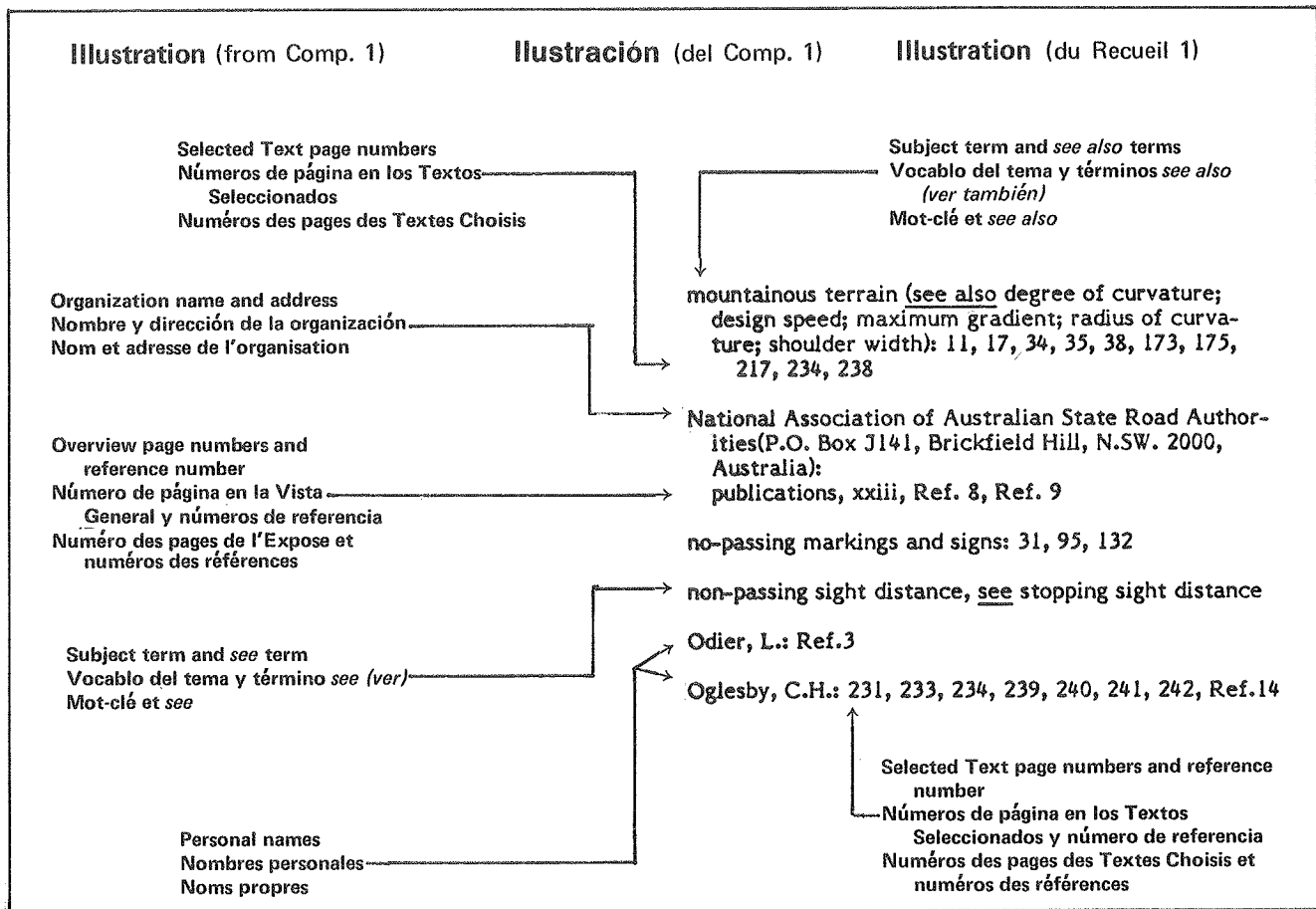
La explicación anterior está subsiguientemente ilustrada.

écrits en chiffres romains se rapportent aux pages de l'exposé et les numéros écrits en chiffres arabes se rapportent aux pages des textes choisis. Les numéros de référence (par exemple, Ref. 5) indiquent les numéros des références de la bibliographie.

Certains mots-clés et noms d'organisations sont suivis du terme **see**. Dans ces cas, le nu-

méro des pages du recueil se trouvera après le mot-clé ou le nom d'organisation qui suit le terme **see**. D'autres mots-clés ou noms d'organisations sont suivis des mots **see also**. Dans ce cas, leurs références se trouveront citées après les mots-clés qui suivent la notation **see also**.

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